NEW ZEALAND EXHIBITION, 1865.

REPORTS AND AWARDS

OF

THE JURORS.

AND

APPENDIX.

DUNEDIN:
PRINTED FOR THE COMMISSIONERS
BY MILLS, DICK & CO., STAFFORD STREET.

MDCCCLXVI.

NEW ZEALAND EXHIBITION, 1865.

PRESIDENT.

HIS HONOR THE SUPERINTENDENT OF OTAGO.

VICE-PRESIDENTS.

THE HONORABLE THE COLONIAL SECRETARY OF NEW ZEALAND.
THE HONORABLE THE COLONIAL TREASURER OF NEW ZEALAND.
THE HONORABLE THE NATIVE MINISTER OF NEW ZEALAND.
HIS HONOR MR. JUSTICE RICHMOND.
THEIR HONORS THE SUPERINTENDENTS OF THE PROVINCES OF AUCKLAND, TARANAKI, WELLINGTON, HAWKES' BAY, NELSON, MARLBOROUGH, CANTERBURY, SOUTHLAND.
MAJOR JOHN LARKINS CHEESE RICHARDSON, M.H.R., M.P.C.

COMMISSIONERS.

JAMES HECTOR, ESQ., M.D.
THOMAS DICK, ESQ., M.P.C., OTAGO.
THOMAS BANNATYNE GILLIES, ESQ., M.H.R.
JAMES PATERSON, ESQ., M.H.R., M.P.C., OTAGO.
WILLIAM MASON, ESQ., M.H.R.
EDWARD BOWES CARGILL, ESQ., M.H.R., M.P.C., OTAGO.
JOHN CARGILL, ESQ., M.P.C., OTAGO.
RICHARD BOWDEN MARTIN, ESQ., CHAIRMAN OF THE DUNEDIN CHAMBER OF COMMERCE.
JAMES RATTRAY, ESQ.
ALFRED ECCLES, ESQ., F.R.C.S.
HENRY CLAPCOTT, ESQ., M.P.C., OTAGO.
RICHARD SEAWARD CANTRELL, ESQ.
WILLIAM HUNTER REYNOLDS, ESQ., M.H.R., M.P.C., OTAGO.
JULIUS VOGEL, ESQ., M.H.R., M.P.C., OTAGO.

Honorary Treasurer: THOMAS DICK, ESQ.
Honorary Secretary: ALFRED ECCLES, ESQ.
Secretary: H. P. MORSE, ESQ.

CONTENTS.

PREFACE.

IT being very obvious that the utility of Exhibitions greatly depends upon the information they may be the means of obtaining and diffusing, the Commissioners at the outset of their labors announced that "Reports of the Juries, containing brief statements of the grounds of their several awards, will be published;" but as the work opened out it became very evident that a bare adherence to this decision would minimise the usefulness of the Reports. The objects of the New Zealand Exhibition were much more comprehensive than those of the merely local Exhibitions previously held in the Colonies, or now so popular in industrial centres in England, but very restricted and humble when contrasted with those of Great International Exhibitions; and it was desired, without pretending to produce Reports of a character to be classed with the splendid economic and scientific treatises contained in those of the International Exhibitions, to endeavor to collect and publish such information with regard to the Exhibits as should assist in their utilisation, and disseminate a knowledge of the great natural resources of the Colony.

It is hoped that these Reports will, in some degree, fulfil these purposes. Some of the most important have been written by the Chairmen of Juries, and are signed by them, whilst in the Appendix are very valuable Supplementary Reports by DR. HECTOR on Class I., and by MR. BALFOUR on the Strength of New Zealand and other Colonial Woods, each the result of very numerous and elaborate experiments, chiefly instituted

expressly for the Exhibition. To these gentlemen the thanks of the Commissioners are eminently due, as well as to all those who kindly undertook the onerous duties of Jurors.

Mr. William Skey was employed by the Commissioners as their Chemical Analyst, under the direction of Dr. Hector, and the results of his investigations will be found embodied in the very instructive Supplementary Report on Class I. in Appendix A.

In some Classes it was deemed advisable to employ a Reporter, and Mr. W. H. Harrison's name, at his request, is appended to those on which he was engaged, but it is to be regretted that the corrections which were necessary in these reports have been the cause of much editorial labor and very considerable delay in publication.

The principal sources of information which have been consulted and often freely laid under contribution, are the Reports of the International Exhibitions of 1851 and 1862, the Catalogues of the South Kensington Museum, various Standard works on subjects relating to the Exhibits, and in Class XXXVI.B. Dr. Thomson's "Story of New Zealand," and Dr. Seemann's "Mission to Viti." I trust the learned Authors will only recognise in the use made of their works a tribute to their value from a remote Colony whose wealth in raw products is almost equalled by her poverty in libraries.

To the Honorable the Colonial Secretary, Mr. Stafford, by whose direction such Tables of the unpublished Report on the Census of 1864, as are completed, have been placed at my disposal, and to the Registrar General, Dr. Bennett, the thanks of the Commissioners are due. The Tables printed in Appendix E have been compiled from those sent to me. I very much regret that I have been unable to prepare Tables of the Revenue and Expenditure of New Zealand, as the materials have not yet reached me; and I must note, that the Table of Exports has been compiled from the "Quarterly Returns," and may therefore not exactly coincide with the "Annual" Table when it is completed. Had I been

able to obtain the materials of these Tables in time, they would have appeared in their proper places in the various Reports.

To my friend Mr. H. P. MORSE, the Secretary to the Commissioners, and my fellow-labourer during nearly three years, for his unwearying and valuable aid, not only in official and editorial labors, but whenever the interests of the Exhibition could be furthered, I am glad of this opportunity of offering my heartiest thanks; and my acknowledgments are also due to Mr. JOHN DICK, (MILLS, DICK and Co.), under whose especial charge these Reports have been printed, for his assiduous care to avoid errors.

In conclusion, I must entreat those into whose hands the Reports may come, to excuse those errors, which though no labor has been spared to avoid them, have, notwithstanding crept into them and been overlooked; they will, doubtless, the more readily do so, knowing that the Editor, whilst encountering the difficulties inseparable from such work in a Colony, could lay no claim to long experience or considerable leisure, but that throughout the whole of this labor of love his time has been primarily devoted to the active duties of his profession.

ALFRED ECCLES,

Honorary Secretary and one of the Commissioners.

DUNEDIN,

5th February, 1866.

NEW ZEALAND EXHIBITION, 1865.

JURORS' REPORTS.

CLASS I.

MINING, QUARRYING, METALLURGY, AND MINERAL PRODUCTS.

JURORS.

JAMES HECTOR, M.D., F.R.S.E. | REV. F. C. SIMMONS, M.A.
J. S. WEBB, Esq.

THE exhibits under this head deservedly occupy a prominent position in the Exhibition, and it is a subject for congratulation that this class has received a large amount of attention. When the vast value of mineral resources is considered, it becomes a matter of the utmost importance, particularly in a new country, that their existence should be ascertained, and their extent, variety, and character made known. The possession of valuable minerals is one of the richest endowments of a country, and without it no country can hope to take a place amongst the great and powerful nations of the world. To Englishmen, who of all others carry with them wherever they go the habits of active industry and commercial enterprise which have raised Great Britain to its position amongst the nations, it is a matter of necessity that the country in which they seek to erect another England, should contain within itself those natural elements which are necessary for the support of commercial and manufacturing prosperity.

That New Zealand has been richly endowed by Nature with the possession of valuable and necessary raw material this Exhibition has fully shown, and in nothing has she been more bountiful than in the mineral treasures which are so widely distributed over this Colony. To

make known the extent and value of these gifts is one of the chief purposes of this Exhibition, and this aim has been accomplished to an extent that few could have anticipated. Few but those who have carefully studied the many varied objects which this Exhibition has been the means of gathering together, can fully estimate the value of the mineral resources of New Zealand; and it cannot be doubted that the knowledge which has been now communicated must tend greatly to their development. In these days of restless commercial activity, and ceaseless and never-satisfied demands of manufacturing industry, no useful product can long remain neglected when once its existence is authenticated. Circumstances may, in some instances, delay the period of utilisation; but, as colonisation proceeds and population increases, will come the demand for new channels of industry, and the arts and manufactures will assume daily increasing importance. The day may be distant when the forests and fertile plains of New Zealand will resound with the clang of the forge or the hum of the factory, and the midnight glare of the furnace illumine the surface of her lakes and rivers, but it is no mean thing for us to know that we have at our hands the elements which will set in motion and feed those great engines of civilisation.

New Zealand possesses all the principal minerals and metals, besides a great variety of those of less importance. The following is a list of the most important, a glance at which is sufficient to show how favourably circumstanced this Colony is in its mineral resources:—

WHERE FOUND.

COAL.—In several districts of the Province of Auckland, viz:—The "Poor Knights" islands, Bay of Islands, Drury, Waikato, Matakana, Kawhia. In the Province of Nelson at Pakawau, West Wanganui, Buller and Grey Rivers, and at intervals along the West Coast. In the province of Canterbury at the Grey River, Kowai River, Mount Harper, Clent Hills, Malvern Hills, Mount Somers, Rakaia, Coal Creek, Rangitata, and Rivers Potts, Ashburton, Tenawai. In the Province of Otago, at Green Island and neighbourhood, Molyneux River, Shag River, and widely distributed throughout the interior, and at various Points on the West Coast.

COPPER.—In the Province of Auckland, at the Barrier, and at Kawau islands, and Wangapurapura. In the Province of Nelson, at the Dun Mountain, Aniseed Valley, and Croixelles, and in detached localities on the West Coast. In the Province of Canterbury, in the Mount Somers

Range. In the Province of Otago, at Moke Creek, Waitaki, Pomahaka, Waipori.

CHROME.—In the Province of Nelson, at the Dun Mountain, Aniseed Valley and district. In the Province of Otago at Milford Sound, and Wakatipu Lake.

GOLD.—In the Province of Auckland, at Coromandel. In the Province of Nelson, at Motueka, Aorere Valley, Takaka River, Wangapeka, Buller River, Lyell's Creek, West Wanganui River, Waimangara River, and in various localities along the West Coast. In the Province of Marlborough, at Wakamarina River and district. In the Province of Canterbury, at the Teramakau, Grey and Hokitika Rivers, and in various localities on the West Coast. In the Province of Otago, widely distributed over the Province; the gold bearing area being included within lines drawn from the Waitaki River to the Hawea and Wanaka Lakes, thence to the head of the Wakatipu Lake, thence to the mouth of the Mataura River, and bounded on the east and south by the sea.

IRON.—In the Province of Auckland, at Pakakura. In the Province of Taranaki, deposited as sand on the Coast. In the Province of Nelson, occasionally. In the Province of Canterbury, near the sources of the River Kowai and elsewhere. In the Province of Otago, as sand in the beds of various rivers, and in the metamorphic rocks, and also in the rocks and schists of the West Coast.

MERCURY.—In the Province of Otago, in alluvial deposits in the Obelisk Ranges, and at Potter's Gully, Dunstan; Serpentine Valley, and Waipori

LEAD.—In the Province of Nelson, in various localities.

PLUMBAGO.—In the Province of Nelson, at Pakawau, Massacre Bay.

SILVER.—In the Province of Nelson, in small veins. In the Province of Otago, at the head of the Wakatip Lake and at Skipper's Gully, mixed with auriferous drift.

BUILDING STONES of excellent character in every Province.

GRANITE.—In immense quantity on the West Coast of Otago, at the Bluff, and at Stewart's Island.

MARBLE.—Chiefly on the West Coast of Otago, at the Horse Ranges, and Nelson.

We shall now proceed to notice the various substances under their separate heads:—

COAL.

A country without coal is deprived of, perhaps, the most powerful agent of civilisation. In these days of steam engines, steamboats, and

railways, on the use of which we are so dependent for commercial intercourse and the provision of innumerable wants, coal, the prime mover of all this vast machinery, is an absolute necessity, and if it be not produced within our own country, we must draw our supplies at great cost from other places. It is a fortunate circumstance that with few exceptions, wherever important British Colonies have been founded, there has also been found a local supply of coal. Thus, the colonists of that race which above all others has attained great national prosperity by means of its vast mineral wealth, will find in their new countries the same agents by which to build up a like greatness.

New Zealand is, fortunately, no exception to this rule. Coal has been found to exist in immense quantity, widely distributed all over the Colony. As yet the absence of cheap means of transit, the dearness of labour, and want of capital, have prevented any extensive development of the coal fields of the Colony; but it cannot be doubted that these drawbacks will decrease with the progress of settlement and the increase of population, and the coal deposits of New Zealand will prove a source of national wealth. A company for working the Brown coal at Drury, in the Auckland Province, is in active operation, and a seam at the Bay of Islands, in the same province, is also being partially worked. Brown coal of good quality is likewise obtained from the banks of the Waikato River, but the aggregate quantity produced is not very considerable, the plentiful supply and cheapness of wood interfering with the demand.

The quality of the Drury coal is very similar to that of the brown coal of Europe, and although inferior to the coal found in the Bay of Islands and in the West Coast of the Middle Island, it is still highly useful as fuel. Full details and analyses of the various Auckland coals will be found in the portion of the reports specially devoted to the Chemical and Physical Character of the Raw Products of the Colony.

Coal has been most extensively found in the Province of Nelson, and the quality of the various seams is superior to any other yet known in New Zealand. This valuable mineral was discovered by some of the earliest settlers in Nelson, and although public attention has been continually drawn to the value of the coal deposits in this province, their development, from the causes already referred to, has been slow. That from the Buller seam, and also from Pakawau, is of excellent quality, and of high steam-generating character. Several attempts have been made to enlist British capital in the working of these seams, but hitherto unsuccessfully. Borings, are being made at Pakawau, in Golden

Bay, with the view of ascertaining the exact extent of the seams. On the banks of the Grey River, seven miles from the coast, a seam of rich bituminous coal, fifteen feet thick, is exposed in such a situation that it may be easily worked. The coal at the Buller is less bituminous than that at the Grey, and is excellent furnace coal; numerous seams have also been discovered at Mohikinui of from five to sixteen feet in thickness. The shallowness of the rivers and the somewhat dangerous nature of their entrances, prevent any but small vessels entering, and the cost of freight is proportionately great.

As these coal fields in the Province of Nelson have every prospect of becoming the most important in New Zealand, the following excellent though condensed account of them, extracted from the columns of the *Nelson Examiner*, August 20th, 1864, is worthy of preservation:—

Coal was first discovered in this province at Motupipi in Massacre Bay a few months after the foundation of the settlement of Nelson, when a party of about twenty laboring men attempted to open a mine and work the coal. Partly, we believe, through want of capital, partly from the want of efficient direction, and partly also because the coal was found to be of inferior quality, the attempt was soon discontinued, and the work for a time abandoned.

Some time afterwards, a piece of coal very superior to any which had been found at Motupipi, was picked up at Pakawau, about 25 miles to the northward of the former working. This led to an examination of the district, and the subsequent discovery of an excellent seam of coal; but unfortunately the seam was not very thick (being we believe not more than three feet thick, and broken by bands of shale, which so far reduced the thickness of the actual coal), and was regarded as being of comparatively little value. Nevertheless, a small local company was formed for the purpose of working the Pakawau field, but, after expending about £300 or £400, the working of this mine was also abandoned for a while. Some trials to which the Pakawau coal was subjected proved it to be, however, of very superior quality.

If our memory serves us aright, before the discovery of coal at Pakawau, Mr. Brunner, by his enterprising trip to the Buller and the Grey, made us acquainted with the existence of large seams of coal on the banks of the last mentioned river, but so great was the difficulty of reaching the West Coast at that time, that the discovery made by that gentleman led to no immediate result.

A discovery of coal near the head of Brook-street Valley, about two miles from the city, next excited interest, and it was at one time believed that a good fuel adapted for domestic purposes might be obtained there. On proceeding, however, to work the seam, it was discovered that the coal was confined to a large landslip from the shoulder of the mountain, and the coal was therefore very speedily lost.

Shortly afterwards, the working of the coal at Motupipi was recommenced, and a considerable sum was expended upon the enterprise. It was surmised that by penetrating deeper the quality of the coal would be found to improve; but although no small quantity of coal was taken out, and the labour of working and shipping it were great, the coal itself did not improve, as had been anticipated, and the working was after a time again discontinued.

A discovery of coal at Enner Glynn, on the property of Mr. A. G. Jenkins, about

a mile from Nelson, revived the expectation that an ample and economical supply of coal might be obtained close at hand for home consumption; but after having been worked with more or less activity for four or five years, and having at one time become an article of regular consumption as fuel, the working of this mine was also abandoned.

All the coal found in the neighbourhood of Nelson, as well as that at Motupipi, was *Brown* coal; the only true coal yet discovered in the Province, and we believe in New Zealand, being that found at Pakawau and on the West Coast, all probably forming portions of one vast field of which Pakawau constitutes the northernmost extremity. It will be proper here to mention, that after the works at Pakawau were abandoned by the Company already referred to, they were taken up by private individuals, and that coal has been continually obtained from thence, of which small cargoes have occasionally been brought into Nelson for sale; but the presence of shale, mingled in considerable quantities with the coal, was necessarily prejudicial to its value. Latterly, however, other parties have taken the works in hands, thicker seams have been discovered, and there now appears to be every prospect of the successful working of the coal mines in this locality.

The coal fields on the West Coast, after remaining neglected and forgotten for fifteen years since their discovery by Mr. Brunner—if we except some additional discoveries of coal by Mr. Rochfort, which excited a transient interest at the time—were at length brought prominently before the public. Mr. Haast*, who was employed by the Government of Nelson to explore the south-western districts of the province, was enabled to contribute a larger amount of information upon the subject of the coal-fields of the Grey than had ever been before known, and what was of still greater importance, discovered the coal-fields at the Buller. Mr. Burnett, a gentleman possessed of very considerable skill and experience as a colliery engineer, who had accompanied Mr. Haast in his explorations, was subsequently employed by the Government to make a survey of both the Grey and Buller coal-fields, and his report published in November, 1862, gave the preference to the Buller over the Grey, as the spot on which it was most advisable to commence working the coal.

Before noting the respective claims of these two coal-fields, and referring to the action which has lately been taken by the Government with a view to obtain coal from each, for the purpose of submitting their relative value and qualities to the opinion of the highest authorities in England, it is proper to observe that sometime after the publication of Mr. Haast's report, the Government sent down a small vessel to the Grey, and by the aid of canoes, got 30 tons of the coal put on board, and brought to Nelson. Mineral leases were in consequence applied for at Mohikinui by parties who expressed a desire to work the coal there, but for reasons which we need not now explain, the project fell to the ground. Coal, also, has been discovered in several places inland, and though promising, in some instances to be of good quality, the discovery was considered of little value, in consequence of the length of land carriage, which must have been encountered in order to bring it to market.

We will now take up the consideration of the Grey and Buller coal-fields, which seem likely to furnish—we trust at no distant day—not only Nelson, but the whole of New Zealand, with a fuel superior to any at present obtainable in the colony. It is possible that Pakawau may eventually compete with the West Coast as a coal-

* The present Chief of the Geological Department of Canterbury, Dr. Julius V. Haast, Ph. D.

field, and we shall sincerely rejoice should such prove to be the case, but the discussion of this question is not necessary at the present moment. Should it happen that coal can be obtained at Pakawau of equally good quality with that found at the Grey or Buller, and be worked as cheaply, the advantage in point of carriage to this port will be all in favor of Pakawau, and will enable it to command the trade of Nelson.

The coal found at the Buller and at the Grey has been supposed to be almost identically the same, and both fields present seams of extraordinary thickness, so that the question of preference has always rested on the relative facility of carriage to shipping and transport by sea. At the Grey a seam of coal fifteen feet thick crops out on the river bank at a distance of seven miles from the mouth of the harbour, but it would require a railway ten miles long in order to convey the coal to that point, since in order to avoid a large swamp which intervenes, it would be necessary to skirt along the mountains, and the distance would be thus so much longer; water carriage not being available for anything save canoes.

To the construction, however, of this railway, no great engineering difficulties present themselves, and so far it would seem that little is left to be desired; but the river is by no means easy of access, especially to sailing vessels, and the bar is liable to shift with every gale of wind. At the Buller, the seams of coal which present themselves to the eye are of as great promise as those at the Grey, but the difficulty of conveying the coal to the shipping is much greater; while the character of the river as a port is much superior to that of the Grey, being by far the best on the West Coast. As the difficulty of land carriage for a few miles can be more easily overcome than the difficulty presented by a shifting bar at the mouth of a river, the Government has very properly directed its attention chiefly to the Buller, in preference to the Grey, as the field of its prospective operations.

The coal-field at Mount Rochfort was discovered by Mr. Haast in July, 1860, on his return journey to Nelson from his exploratory trip to the western district of the Province, made under the direction of the Government.

Mr. Haast, on reaching the Buller, determined on crossing the Papahaua range, so as to reach the Orikaka (a tributary of the Buller), with a view to increase his knowledge of the topographical features of the country. Whilst crossing this chain of mountains (the highest peak of which, Mount Rochfort, is 3,572 feet high, and overlooks the mouth of the Buller river), Mr. Haast discovered, on a plateau at the back of Mount Rochfort, such strong indications of the presence of coal as induced him to prosecute a search for it. In the narrative of his journey, published by the Provincial Government, we find the following account of this discovery:—

"We left part of our provisions and one tent at Mount Rochfort, the weather still remaining magnificent, though very cold. On descending to the plateau, we found it worse than our anticipations. It was extremely broken, and we were kept climbing up and down the whole day without intermission. As it offered plenty of sections, however, I hoped every moment to discover coal; but, although I searched with the greatest diligence, removing for that purpose snow and ice from the sides of the hills, I did not at first succeed in finding any. In the evening, however, we found some small pieces of coal in one of the brooks near our camp, and I at once, accompanied by Mr. Burnett, followed these indications until night began to close upon us. The next morning we again followed the same stream, the pieces of coal became more angular, and we at last reached a narrow valley, the rocks of which on both sides overhung. The rivulet here disappeared amongst huge masses of rock covered with deep mosses, and lying one on the top of the other so as to form an irregular cavern.

This we attempted to explore with lighted vestas, wading in the icy waters, but the opening soon became so narrow that we were unable to proceed. It was evident that a coal stratum, probably of great thickness, had here been washed away, the overlying rocks falling in. Although this valley was probably not more than 2,000 feet above the level of the sea, deep snow lay in it, and in some places the ice was so thick as to permit us to enjoy the pleasure seldom obtained in New Zealand, of a slide upon the ice.

"Our road led us next day over the same kind of ground, and I still looked anxiously for indications of coal, but in vain. At length, however, my search was rewarded, for having passed up a little waterfall in a deep gully, I saw that the overhanging rocks were compact grits, and although my whole party had passed over the fall, I at once returned, and having removed the moss which covered the stratum, below these grits I found, to my great joy, a large seam of good coal. Of course I stopped my party, who very soon returned to assist me in uncovering the seam, which, on removing the ice that encumbered the fall, proved to be eight feet two inches in thickness of *pure coal.* A further examination of this valley, which I named Coalbrook Dale, proved that this seam was striking and dipping regularly, and I therefore at once took measures to fix its position."

The Government of Nelson took no efficient measures towards the exploration of this coal-field until the early part of the year 1862, when Mr. Burnett was instructed to undertake the task, and the result of that gentleman's labours was given in a report published in the *Provincial Government Gazette* in the following November. Mr. Burnett's report was highly satisfactory as regarded both the quality and the quantity of the coal obtainable in Coalbrook Creek, the single drawback being that the seams found were not very accessible from the sea. In speaking of this coal-field Mr. Burnett says:—

"I am not prepared to speak confidently as to the quantity of coal contained in this plateau, but I know of five workable seams, none less than five feet thick, giving a total thickness of 38 feet 6 inches, all of really good quality, and equal, if not in some respects superior to the Grey coal. I supplied small samples of four of these seams at the time of my first report, and on my return from the Buller, the last time, I brought about 60lbs. of the other. This I believe to be the best sample that has yet been brought from the West Coast. I may remark generally, that these seams are remarkably free from shale and foreign matter; and when a seam is spoken of as being so many feet thick, it means that there is that thickness of *pure coal.*

"I do not say that the whole of these seams will be found all over the plateau, neither can I be certain that some that are mentioned as different, may not be the same cropping out in different places, for without actual mining, it is impossible to trace seams of coal for miles over a rough country. There are many smaller seams known to me in different places, but under the circumstances, I consider anything under 3 feet as unworkable, and have not included such in the 38 feet 6 inches mentioned above.

"It is reasonable to suppose that in such a rich field, almost entirely unexplored, many seams have yet to be discovered; but without calculating more than is actually known, the following figures will give some idea of the capabilities of this part of the coal-field: 15 square miles, or say 10,000 acres, a moderate estimate of the extent which is available at once—calculating only 18 feet of coal, (instead of 38 feet 6 inches), over the whole extent.

"Now as a cubic yard of solid coal will produce a ton, every acre of a 3 feet seam will yield 4840 tons.

"Then, 4840 tons × 6=29,040 tons per acre 18 feet thick; and 29,040 × 10,000 =290,400,000 in 10,000 acres. But supposing only half of this can be calculated on there still remains 145,200,000 tons.

"And supposing half of this to be lost in the working, we still have 72,600,000, tons of available coal, and this is only one-eighth, supposing all the seams known to exist over the whole 10,000 acres.

"I think in this calculation there is a margin for all contingencies, particularly as the discovery of more coal is not calculated upon. I can therefore state positively that on this particular part of the coal-field there are 72,600,000 tons of coal which may be brought to the Buller harbour by means of a railway in no place exceeding eighteen miles in length; but for many years twelve or thirteen miles would be sufficient, and possibly only nine.

"This 72,600,000 tons would supply 2,000 tons a day, or 600,000 tons a year, for 121 years."

Here unquestionably enough is promised to induce a company to undertake the working of this coal-field, supposing that this coal could be transported to the shipping at Westport; and this was the question which next engaged Mr. Burnett's attention. The plateau where the coal crops out lies 1800 feet above the sea level; but unfortunately this is not the only difficulty to be encountered, for a shoulder of Mount Rochfort intervenes, which is 200 feet above this plateau, and the coal found in Coalbrook Dale will therefore have to be raised 200 feet above this plateau and must then descend 2000 feet. In order to overcome this difficulty, Mr Burnett proposes the construction of a railway, the length of which would be twelve miles, at a roughly estimated cost of from £70,000 to £80,000. Mr. Burnett calculates that it would require a capital of £100,000 to open the mine and place the coal on board ship; and the interest of the capital sunk in the undertaking, the cost of working 100,000 tons *per annum*, maintaining the line of railroad and sundry other concomitant expenses, would cost the lessees of the mine 8s. 2½d. on the coal delivered at Westport.

Mr. Burnett in a subsequent report (March 6th, 1863) gave it as his opinion that a seam of coal might be struck on the seaward side of Mount Rochfort at no higher elevation, probably, than 600 feet above the sea, which would avoid three miles of the worst part of the railway line, and also 1500 feet of ascent. With a view to ascertain whether this supposition was founded on fact, boring has been commenced under Mr. Burnett's direction, and should his conjectures prove correct, the most formidable features in the attempt to work the Buller coal-field will have been surmounted.

In the Appendix to this Report will be found detailed particulars of the various Nelson coals.

Coal of moderately good quality has been worked at the Kowai seam in the Province of Canterbury, but not to any important extent.

Throughout the Province of Otago coal of various quality is being worked to a considerable extent. The scarcity of wood in the interior, and particularly on the more important gold-fields, causes a demand for other fuel, and numerous beds of Brown coal have been opened and are being successfully worked. The quality of these deposits varies, but usually the fuel is found applicable for domestic purposes. On the east coast,

along the base of the Kakanui Mountains, Brown coal has been found of superior quality, and also near the mouth of the Clutha—the coal at the latter place being probably the first seam discovered in New Zealand. Coal has also been found on the West Coast of Otago, of excellent quality.

Leaving the exact classification and comparison of these coals to that portion of these Reports specially devoted to that subject, it will be seen from these cursory observations that coal is widely distributed throughout the Colony, and most probably extensive deposits exist also in localities where their presence is little suspected, but which the progress of colonisation will reveal.

New South Wales, from which at present the principal supply of coal for this Colony is derived, possesses very extensive coal-fields, yielding coal of very superior quality. The Exhibition contained some magnificent blocks of coal, forwarded by the Waratah Coal Company, the Newcastle Wallsend Coal Company, Messrs. Morehead & Young, and the Australian Agricultural Company. The Waratah Company exhibited three blocks of coal, showing, when placed above one another, the character of nine feet six inches vertically of the thirteen feet seam of one of the Company's workings. The descriptive comparison of the coal-fields of New South Wales, from a New Zealand point of view, has been lately made in an able Report by Mr Burnett, published in the *Nelson Examiner*, and which it has been considered advisable, in connection with this important subject, to reprint at length :—

From the researches of Leichardt, Rev. H. B. Clarke, of St. Leonard's, near Sydney, Messrs. Keene and Mackenzie, Government Examiners of Coal Mines, and others, it would appear that almost the whole east coast of Australia, from the tropic of Capricorn to Shoal Haven, in 35° south (an extent of 12° of latitude), is composed of carboniferous rocks. Its extent into the interior is of course not so well defined, but the same formation is reported by Sir Thomas Mitchell to exist in the Grampian Mountains, west of the meridian of 143°; though whether it continues from the coast so far inland, is, I presume, not yet ascertained; however, there is no doubt that this is one of the largest and most important coal-fields in the world. It contains great numbers of seams of almost every thickness up to thirty feet, and is, generally speaking, remarkably flat and regular, but broken through in places by basaltic dykes. The coal is of course very varied in quality, but generally good, and is at present being worked at several places in this magnificent field; the principal being near Newcastle on the Hunter River, and the neighbourhood of Wollongong, in the Illawarra district, both in New South Wales; and also near Moreton Bay, in Queensland. As I have only visited the two former districts, I will confine my remarks to them.

In the neighbourhood of Newcastle there are seventeen seams, from three feet to twelve feet thick, and of various qualities, several of which are worked in the dif-

ferent collieries of the district—some by free level, but generally from shafts from 86 feet to 365 feet deep. They are not much troubled with water, and, as a rule, the pumping apparatus is worked by the winding machine, and this is found sufficient to keep the mines dry. Through the kindness of Mr. J. B. Winship, the Colliery Viewer of the Australian Agricultural Company (generally known as the A. A. Co.), we were enabled to inspect their very fine and extensive mines. One of the principal of these is 200 feet deep, 14 feet diameter, and bricked from top to bottom, as it is through soft clay with a great deal of quicksand, and was sunk with great difficulty. The seam at this shaft is about 11 feet thick, mostly clean coal, with two small bands; it is worked on the North of England plan of "pillar and stall," eight yards being taken away and five yards being left to support the roof, five feet of the bottom is worked off a few yards in advance, and the remainder brought down afterwards; the partings are good, and the coal, though hard, is free; very little timber is used even in these wide workings, which shows that the roof is strong and good; there is a slight dip of about 1 in 20 to the S.W., and, on the whole, it is very favorable for working. Mr. Winship says that, in about one mile and a-half, this seam varies from three feet to twelve feet in thickness. The coal is brought from the face of the workings to the bottom of the shaft in waggons, each containing half-a-ton, and drawn by horses; two of these loads are taken up the shaft in one cage three times a minute, *i.e.*, three tons per minute, so that 1,800 tons may be drawn out of this shaft in ten hours constant work, or, allowing for delays, say 1,400 tons; but the greatest quantity yet raised in one day of ten hours was 993 tons. There are 280 men digging coal, exclusive of those employed in other work both above and below ground. The men are paid 4s. 3d. per ton for the bottom and 3s. 9d. per ton for the top coal, or say, roughly, 4s. per ton for merely digging and putting it into waggons; the other expenses of haulage to, and drawing up the shaft, screening, putting into railway waggons, and other work above and below ground, amounts to 2s. 6d. per ton, so that the coal costs 6s. 6d., per ton in railway waggons at the pit's mouth. From there it is drawn by the locomotive engines about two miles to the shipping place, and sold on board ship at 10s. per ton, or more generally 9s. per ton in the case of large contracts; thus leaving only 2s. 6d. per ton for haulage from the mine to the shipping place, putting on board ship, wear and tear of material, and interest of money, &c., &c. Two years ago the price of coal on board ship at Newcastle was from 13s. 6d. to 14s. 6d. per ton, and this great fall in the price is having a most depressing influence on the mining interest, many collieries being worked at a great loss, and few if any doing more than paying expenses.

The coal from the A. A. Co.'s mines is conveyed along the private railway to the private shipping places of the company, where vessels of large size are loaded by simple shoots from the railway waggons. Everything connected with their works is substantially good, and the arrangements, both above and below ground, reflect the greatest credit on the manager of the works.

The company is very wealthy, a great deal of the land in and surrounding the town of Newcastle being their private property, and this land is being sold at from £3,000 to £5,000 per acre. There is no Board of Directors in the colony, and the whole executive power of the company is vested in the hands of the General Superintendent, and the Colliery Viewer, so that, on the whole, the A. A. Company is in as good a position for producing coal cheaply, and in large quantities, as any other mining establishment in the Newcastle district.

The coal from some of the other collieries is brought by private railways to the Hunter river, and there discharged into boxes placed in barges, which are, by steam

tugs, towed down to the port to vessels anchored in the stream; the boxes are then lifted by steam cranes, the coal discharged into the hold of the vessel, and the boxes replaced in the barges, to be sent up the river again for a fresh supply. But the greatest quantity is brought by the Government railway, in boxes containing four tons each, two of which are placed on one waggon. As the railway is continued to the end of the wharf, these waggons are placed close alongside the ship to be loaded; the boxes are then lifted by steam cranes from the waggons to the ships, the coal discharged, and the boxes returned to the waggons. This operation requires about four minutes, or one ton per minute; but, allowing for the removal of waggons and other delays, one crane is capable of putting about forty-five tons per hour on board ship. For the use of the cranes the Government charges 6d. per ton, and extra for the weight of the box, say roughly 2s. 6d. for each box of four tons. Doubtless, before long, arrangements will be made to elevate the railway high enough above the water to allow the waggons to discharge themselves at once into vessels, without the aid of these cranes; for, fine pieces of machinery as they are in themselves, they are clumsy makeshifts when applied to shipping coals, and ought to be abandoned as soon as possible, as a bulky article like coal should never be lifted after it is out of the mine, till it is put on board ship.

These remarks apply particularly to Newcastle, where the powers of producing coal so far exceed the powers of shipping it; not only are vessels often delayed for weeks in the port, but the mines are stopped because ships cannot be loaded fast enough. The great want at Newcastle is wharf accommodation, and an economical and expeditious mode of shipping coal.

The harbour itself is, naturally, pretty good, has been very much improved, and is still capable of great improvement, particularly in internal arrangements. It is formed by the mouth of the Hunter river, which discharges itself into the sea seventy-five miles north of Sydney, and is protected from the open sea by a reef of rocks stretching out from the main land on the south side in a N.N.E. direction, nearly parallel with the line of coast north of the river. At the end of this reef there is an isolated flat rock, upwards of 100 feet high, on which the lighthouse and signal station are situated. This reef, over which, in its natural state, the sea breaks furiously in east and south-east gales, has been taken advantage of as the foundation of a breakwater, which has been constructed at a great expense; so that the interior of the harbour is now thoroughly well sheltered from all weather. From the N. and N.N.E. it is naturally protected by the overlapping of the coast, so that the harbour is both safe and easy of access in almost any weather, and, except in severe E. and S.E. gales, can be entered or left at any time; indeed, from what I have heard, there are very few days in the year when vessels cannot enter or leave the port in safety. The breakwater, however, on which so much depends, will be a constant source of trouble and expense, for in S.E. gales, which prevail on this coast, the sea breaks heavily against it. While we were there it was very much injured, and, except prompt and vigorous steps are taken, I will not be at all surprised to hear that in some of these gales the sea has made a clean breach through it, and exposed the inside of the harbour to the open ocean. Of course, this can be prevented; but I think it will be a difficult and an expensive undertaking permanently to secure such a work against the force of the waves.

The entrance of the harbour is by no means wide, and in one part it is divided into two narrow channels by what is termed the "Entrance Rock," nearly in the centre of the deep water passage; but as this is well inside, and in smooth water, it is of comparatively little consequence. The least water is twenty feet, with a rise and fall of

tide of from three and three-quarters to five feet. Ships of 1,000 tons enter the harbour, but do not take a full cargo. I should say that vessels of from 300 to 600 tons are best adapted for it. There is a large extent of shoal-water and mud-flat inside, extending for a considerable distance up the Hunter; much of this has been already reclaimed, and the work is still progressing, so that the deep water frontage, with valuable land for commercial purposes, is constantly increasing. Eventually, the harbour will be able to accommodate a large fleet of colliers, even now it is a remarkably busy, lively, flourishing little port, and a wonderful example of what a place may be made by coal alone. A dozen years ago Newcastle was a mere village, with only one colliery of any importance working, and had a one horse tramway for taking coal from the mine to the shipping place; now it is a thriving district, with a population of 8,000, nearly 4,000 of whom live in the town and suburbs. More than 1,000 tons of coal are shipped daily, the harbour is constantly alive with ships and steamers, and locomotive engines with trains of coal, and other goods, passengers, &c., are constantly rushing about, giving the whole very much the appearance of a small seaport town in England. It has a rapidly increasing trade, and a solid foundation of future prosperity in its magnificent and inexhaustible coalfield, which is being worked and developed with talent, energy, and enterprise worthy of its vast importance.

I was informed by Mr. Winship that on some estates of the A. A. Company situated in Port Stephens, some thirty miles further along the coast, north of Newcastle, there is a seam of coal thirty feet thick, and an abundant supply of good ironstone in the immediate neighbourhood, both near deep water frontage. This being the case, and Port Stephens being a very fine harbour, there can be little doubt that, before long, ironworks will be established there on a large scale, particularly as these valuable minerals belong to such a wealthy and enterprising company.

About twelve or fifteen miles south of Newcastle is the entrance of a very large inlet of the sea, or rather saltwater lake, called Lake Macquarie. This lake is very irregular in shape, about fifteen miles long, and varying in breadth from one to five miles; round its shores, which are composed of the same regular flat sandstone formation, so characteristic of this part of the Australian coast, a coal seam thirteen feet thick crops out close to the water, so that vessels can be moored alongside of the mouth of a mine; but this advantage is counterbalanced by the circumstance that the entrance to Lake Macquarie is not only exposed to the open ocean, but is very shoal, having a shifting bar, with a depth of only from four to eight feet at high water. In spite of this very serious drawback, coal is about to be worked there by an enterprising company, which has had two iron flat-bottomed schooners sent out from England, for the purpose of conveying coal from there. I saw one of these vessels on the patent slip, in Sydney; it was 90 feet long, 17 feet·6 inches broad, with 5 feet 6 inches depth of hold, registered 90 tons, but to carry 100 tons of coal when loaded, drawing at the same time 2 feet 9 inches of water, but with a centre-board, to be used when needed. That these vessels, in spite of their peculiar construction, are pretty good sea-boats, is proved by the fact that they both sailed out from England; before a strong breeze they will go eleven miles an hour, and work to windward in a gale without ballast. This style of vessel might, I think, meet some of our requirements in New Zealand, particularly on the West Coast. Whether with such great disadvantages in harbour, the coal at Lake Macquarie will be able to compete with that of Newcastle, is yet to be proved, but the very attempt shows the importance attached to this branch of industry in New South Wales. Certainly to

work a bar harbour, with only from four to eight feet of water at high tide, and for colliery purposes, appears to me almost hopeless.

South of Newcastle and Lake Macquarie, the same formation continues, but the coal-seams are below the level of the sea, and are not seen again till they appear on the coast about forty miles south of Sydney, in the Illawarra district, where they are worked in various places, the principal being Bulli, Bellambi, and Wollongong. From this it would appear that the whole of the coal-field is actually under the City of Sydney, though at what depth or in what condition is not yet ascertained.

Being anxious, before leaving New South Wales, to see the southern part of the coal-field, and having letters of introduction from Mr. Watkins, of the New Zealand Bank, to Mr. Waring, Mayor of Wollongong, we started by railway from Sydney to Campbelltown, and took the coach from thence. After passing a small village called Appin, about ten miles from Campbelltown, we rose rapidly on to a sort of barren table-land, covered with flat coarse sandstone rocks, stunted scrub, and a little native grass, the whole very much resembling the table-land of Mount Rochfort, both as to its geological formation and the character of its vegetation. This continues for many miles, till the road begins to descend the seaward edge of the plateau, which is a steep mountain side about 1,500 feet above the sea, overlooking the coast from Bulli to Wollongong. On the side of this hill the coal crops out in thick seams, and has been traced twenty miles further south, gradually rising in that direction. There is no doubt that it extends under the table-land I have spoken of, thus forming a large district rich in coal, in a very accessible position.

At the edge of the plateau the character of the country rapidly changes; the stunted scrub is succeeded by fine heavy timber, with a dense growth of underwood and every indication of good land. This continues to the sea coast, and for thirty miles along it to the south. It is called Illawarra district, and is the finest country I have seen in New South Wales. With a long frontage to the sea, it is backed by a range of mountains, along the side of which fine seams of coal can be worked by free level, almost the whole length of the district. The distance of these mountains from the sea, in the widest part, is about fifteen miles, and the whole of this is fine undulating country, fit for agricultural purposes. It is extensively cultivated and laid down with artificial grasses, and is celebrated as a dairy district. But along the whole coast there is no good natural harbor, vessels generally taking in and discharging cargo in the open roadstead, or alongside the jetties put out in the open sea.

At Wollongong we visited the Mount Pleasant and Mount Keira mines, both working the same seam, which is about seven feet thick, and crops out on the hill side about 600 feet above the sea. It dips into the hill about one in twenty, and, at Mount Pleasant, is drained by a drift from a lower level, which cuts the seam 200 yards from the mouth of the mine, the water, from the workings further in, is brought to this water level drift in waggons, three men being employed at this work night and day; but a new drift is in progress from a lower level still, which will drain a considerable breadth of coal further to the dip. The coal is brought out of the mine up a slightly rising tunnel, by the ingenious arrangement of an extra drum on the self-acting incline (which conveys the coal from the mouth of the mine to the level land below), by which the full waggon going down not only draws an empty one up from the bottom of the hill, but also a train of six half-ton waggons out of the mine at the same time. At Mount Keira a small steam engine is employed for that purpose.

The coal, from both these mines, is conveyed down self-acting inclines to the level railway. In one case (Mount Pleasant) by a single plane about half a mile

long, at an angle of about one in four and a half, but the gradient is by no means regular; the line, however, is perfectly straight, with three rails from top to bottom, and a short piece of double way in the middle. Only one waggon, containing 25 cwt. of coal, is sent down at once, and requires two and a half or three minutes to make the trip.

From Mount Keira the coal is taken down, from about the same height, by a series of three inclines, to suit the natural slope of the ground which has been very little changed, the rails being laid almost on the natural surface. The first of these has a gradient of about one in three or three and a-half, the second, one in five or six, and the third so flat that it can scarcely work with good effect. These gradients are not from accurate measurement, but are roughly estimated, for in no case is it at all regular from top to bottom, but the lines are invariably, perfectly straight. From the bottom of the hill the coal is drawn by horses about two and a-half miles along separate lines of tramway, to the shipping place at Wollongong. These tramways are by no means substantial, being merely bars of iron fixed on wooden rails; and I was very much surprised to find the same rails not only on the level, but also on the remarkably steep inclines I have just described. Certainly the traffic is not heavy, 100 tons a day being, I should say, very much more than an average from each place.

At Wollongong there is no natural harbor, but a roadstead, rather sheltered from the S.E. by a point of land and a reef of rocks. An artificial basin of small extent has been formed where vessels of eighty and one hundred tons load; and a new one is at present being made by the Government, at an enormous expense, as the whole is cut out of the solid rock, and the stone for the quay walls, &c., is brought from Sydney. The new basin is to be six feet deeper than the old one, which is also to be made the same depth and the two united; to do this of course it will be necessary to dam the sea out for some considerable time, which will be a serious difficulty. The whole extent of the excavated harbor, when the two basins are united, will be about two acres, and, besides this, there will be anchorage for a few vessels in still water, behind the mole formed by the *debris* from the harbor excavations.

About eight miles north of Wollongong are the mines of Bulli and Bellambi, the former of which we examined both above and below ground. The seam worked is the same as at Wollongong, but here it is only about 400 feet above the sea; it is about eight feet thick, with a dip of one in twenty in a northerly direction, and, as it rises into the hill, the water runs out of itself. It is clean coal the whole thickness, but very much disturbed by what the miners call rollers, which are formed by the floor of the seam rising in some cases nearly to the roof, and stone taking the place of coal. The roof is not altered in its position by these irregularities, but is often soft and broken where they occur, and the coal itself is always injured a few feet on each side of them. These rollers appear to be nearly parallel, and the idea suggested by them is that the coal has been deposited on a series of sandhills. Of course, in the main roadways, these rollers must be driven through, and, as the rock is often hard and difficult to work, this operation sometimes costs from £20 to £30. The coal between them is worked in places six yards wide, but the quantity lost and injured, over and above the trouble and expense, is a very serious drawback to the profitable working of the seam.

The coal is brought out of the mine in half ton waggons, six drawn by one horse; it is then screened into waggons holding sixtyfive cwt., very strong and ponderous, and sent down a self-acting incline, one waggon at a time. This incline is about 600 yards long, with a gradient of nearly one in six, perfectly straight and with a double

line of rails the whole distance. From the bottom of the incline the railway falls about one in forty for a little more than a mile to the shipping place, so that the full waggons run down by their own weight and are taken back when empty by horses and bullocks. All the railway work is good and substantial, the rails being of malleable iron, strong enough for light locomotives.

The shipping place is merely an open roadstead, with no shelter whatever, and yet over the bare flat rocks a very fine jetty has been run out into the open sea. This jetty was originally constructed of a number of separate frameworks of four posts each, strongly braced together, and supporting a heavy beam on which the roadway (consisting of a double line of rails) rested; these frameworks were placed one in front of the other at intervals of ten feet, strongly braced, but merely resting *on the rock*, with nothing to keep the whole fabric in its place but its own weight, and the way it was united into a compact and solid mass. A short time ago the end of this jetty was washed away in a storm, and has since been replaced by a modification of the same plan, each framework now having only two posts instead of four, placed at intervals of twenty-five feet instead of ten feet, braced with iron, the whole of the upper part of the roadway, &c., being very heavy. By this plan not only is there a great saving of timber (for in a length of fifty feet only six posts are required instead of twenty-four), but the whole thing offers much less resistance to the waves; and, as it has stood several severe storms since it was repaired, sanguine hopes are entertained that it will be permanent. At the end of this jetty, at high water, there is a depth of twenty-five feet. It is a bold and spirited undertaking and deserves success, and is another example of the difficulties which are met and overcome in developing this great coal-field.

The Bulli mine is let from year to year to a contractor, who delivers coal on board ship at 3s. 11d. per ton, the owners of the mine finding all the plant, and the contractor keeping everything in good order. Coal is put on board vessels of eighty or a hundred tons here, taken to Sydney and there re-shipped. A considerable quantity goes to China, where it is said to be in good demand, though it is inferior to most of the Newcastle coal.

The whole of this district is peculiarly interesting to us, for the position of the coal seams is very similar to those on the West Coast, and the mode of working is very much the same as must be adopted there.

COPPER.

This valuable metal is found in various parts of New Zealand. Ore of rich quality was discovered several years ago on the Great Barrier Island, on the Auckland Coast, and an English company was formed for working it. From various causes the company has not been financially successful, and the development of the deposits has not progressed. Some fine specimens of this ore were exhibited in the Auckland collection, as also samples from the Kawau and Wangapura.

The presence of copper in the Nelson province has been known for many years, and at one time hopes were entertained of establishing extensive workings. Ore of rich quality was found to exist in the Dun Mountain, a few miles from the Port of Nelson, and the glowing accounts

given by the discoverers, as to the quality and quantity of the ore, led to the formation of an English company, which incurred a vast outlay for the purpose of developing the deposits. Subsequent investigations, however, proved that the lodes at present discovered were not sufficiently extensive to prove remunerative, and the workings for copper were abandoned. In other localities in the neighbourhood of the Dun Mountain copper, ore of very high percentage, but in small quantities, has been found, but as yet nothing of importance has been accomplished in the way of mining for it. Very fine samples of copper ore were exhibited in the Nelson department, some of which were of extraordinary richness.

Copper ore in the shape of Pyrites and Green Carbonate has been discovered in the Province of Canterbury by Dr. Haast, Provincial Geologist, but not in important quantity.

Within the last two years important discoveries of copper have been made in the Province of Otago, the ore in some instances being of very rich quality. The principal deposits have been found at Moke Creek, in the Wakatipu district, in the neighbourhood of Waipori, where it occurs, apparently, in regular lodes, containing from 14 to 25 per cent of copper. It is in the form of a mixed sulphuret of copper and iron, much intermixed with quartz. Native copper has also been found at Kawarau, Dunstan, and the Waitaki. It is satisfactory to be able to state that there is a probability of these copper lodes being extensively worked, companies having been formed for that purpose.

The importance of developing these and other metalliferous deposits cannot be too much enforced; and copper particularly is one of those metals, the supply of which is barely adequate to the demand. Of late years the mines of Cornwall have shown a large falling off in production, and many of the existing mines are stated on good authority to be exhibiting signs of exhaustion, with the exception of those yielding yellow ore. Thus, with the declension of the home supply and the yearly increase in the demand, the price of copper must be maintained, if not enhanced. According to authoritative statistics the average value of the ore produced by the mines of Cornwall in 1863 was about £5 to £6 per ton.

Specimens of the ore from the Moke Creek were exhibited by Mr. J. B. Bradshaw, and samples of ore from other localities were shown in the Museum collection of Dr. Hector.

CHROME.

This useful mineral has chiefly been found in the Province of Nelson

at the Dun Mountain, where it has been extensively worked. It was first brought into notice by Mr. T. R. Hacket, who also in 1861 opened a mine in Aniseed Valley, in the same district. Chrome is extensively used in the arts, for making pigments. From it also is made chromic acid, a valuable agent in bleaching and dyeing. Owing to the lessened demand in England for this mineral, the price has fallen from £10 10s. per ton to £5, and at the present time it is not found remunerative to work the mines in this colony. The quantity of chrome exported from New Zealand amounts to about 5000 tons. Specimens of the mineral were exhibited in the Nelson department by the Dun Mountain Co., and Messrs. Levien & Hacket. Mr. T. W. Tatton also exhibited interesting specimens of the manufactured ore in various stages of preparation; as also pigments of brilliant colors produced from it.

At Milford Sound, on the West Coast of Otago, Dr. Hector discovered specimens of chromic iron. At Martin's Bay, on the same coast, he also found this mineral occurring intimately speckled over a large block of nephrite, or jade. It has also been found in the Wakatipu district. Specimens of the mineral from the above-mentioned places were exhibited in the Museum collection of Dr. Hector.

GOLD.

If New Zealand can boast of its deposits of the baser metals, it can also lay claim to the possession of some of the richest goldfields in the world, for the area they occupy. The enormous impulse which gold discoveries give to colonisation, and the extraordinary commercial progress which they induce, have been strikingly manifested in modern times. California, Australia, British Columbia, and New Zealand, all afford instances of the wonderful effects which are produced by the development of auriferous deposits. As agencies in colonisation, gold discoveries exercise a gigantic influence. They draw population, lead to the opening up of desert wilds to civilisation, and carry in their wake all the industries necessary for the progress of a numerous population. In New Zealand, gold has effected transformations impossible under the ordinary process of colonisation. Busy and thriving populations are in a few weeks planted in localities previously remote and unknown. Tracts of country which under other circumstances would rest in their primeval desolation for many years, become suddenly thrown open, and prosperity rapid and brilliant is created. All this is still being done in New Zealand, and the progress of discovery is gradually revealing the existence of rich auriferous deposits in almost every part of the Colony.

Gold is now being successfully worked at Coromandel in the Province of Auckland; at Massacre Bay, and in the Buller, Lyell, Wangapeka, and other western streams in the Province of Nelson; at the Rivers Grey, Teremakau, and Hokitiki, and over a considerable line of the western coast of the Province of Canterbury; and over a vast area in the Province of Otago.

The first authentic discovery of gold in New Zealand was at Massacre Bay in 1842, by an exploring party under Captain Wakefield, but the discovery did not attract much attention at the time. From that period until ten years afterwards nothing further was done in the way of discovery, but in 1852 gold was discovered almost simultaneously in the Provinces of Auckland and Otago, and as the important discoveries which had been made in Australia caused more interest to be felt in the subject, public attention was excited and efforts were made to develope this new resource. The Auckland discovery was made at Coromandel, but only some 1,100 ozs. was the result, and the district was soon abandoned. In 1856 attention was called to the existence of gold by the Surveyor-General of New Zealand, Mr. C. W. Ligar, who reported that he had found the metal very generally distributed in the gravel and sand of the Mataura river. Mr. J. T. Thomson, the Provincial Surveyor, also found gold distributed over several localities. In the same year, further discoveries were made in the Province of Nelson at Motueka, and in the following year attention was again drawn to the existence of gold at Aorere, Massacre Bay. A rush was the consequence, and about 1000 persons were for some time employed with moderate success, but the want of roads and the severity of the winter speedily reduced the population. Up to the end of October, 1858, sixteen thousand four hundred and seventy-three ounces of gold was exported from this district.

The richest diggings on the Aorere goldfield were on the Slate River, a stream which takes its rise in the Anatoki Range, and afterwards falls into the Aorere. On each side of the river are high precipitous banks, composed of slate, quartz, and granite rocks, 400 to 500 feet high, and mostly clothed with dense forest to the water's edge. The gold was found in yellow gravel, associated with the raw metal, Osmiridium, on the ridges and crevices of the river bed. Gold was traced up into the Anatoki or Snowy Range.

In the latter part of 1857 several persons made known the existence of gold in Otago. Mr. Sub-Assistant-Surveyor Gillies and party, found gold in a creek running between the Waikioi and Makerewa Bush, and

emptying itself into the Makerewa. About the same period, Mr. Assistant-Surveyor Garvie, whilst on a reconnaissance survey of the south-eastern district of the Province, found traces of gold in the gravel and sand of several streams and rivers. The gold found was small and scaly. In March, 1858, Mr. Garvie brought to Dunedin the first notable specimens, which were obtained by Mr. John Buchanan (now of the Geological Survey Staff), from the river beach in the Dunstan Gorge, which four years afterwards proved so remunerative to Hartley and Reilly, and ultimately led to the opening up of the most extensive Goldfields in the Province. In the same month, gold was discovered in the surface gravel near the mouth of the Tuapeka River. Gold was also found in the Lindis River during the same year.

Further discoveries continued to be made in the Nelson Province, and in 1859 some large nuggets were found in the Rocky River, weighing from two to nine ounces. In 1861, several important discoveries were made in this Province, in the Wangapeka River, and in the Buller River, on the West Coast.

In March, 1861, gold was found in the River Lindis in considerable quantity. It consisted of water-worn nuggets about the size of a bean. About this time, also, gold was found on the Kakanui, near Moeraki. In June of this same year a discovery was made from which may be dated the importance of Otago as a gold-bearing country. Mr. Gabriel Read had been led by curiosity to attempt to verify the reported presence of gold, and in the course of his prospecting expedition had examined the ravines and tributaries of the Waitahuna and Tuapeka Rivers. With only a tin dish and a knife for his tools, he succeeded in collecting seven ounces of gold in about ten hours, and ascertained the existence of the metal in several creeks and gullies. As soon as Mr. Read's statements were authenticated, a great rush of population took place, and discovery after discovery rapidly followed each other, until the fact of an extensive goldfield was established.

In the early part of 1862, further discoveries were made at Coromandel, where a considerable number of miners proceeded, and several companies were formed for the purpose of working the quartz reefs in which the gold is found. The gold-diggings on the west coast of Nelson gave also promise of abundant yield, and some very brilliant finds were made. In the month of August, a discovery was made known in the Province of Otago, which in its results exceeded in importance those of the previous year. Two men, named Hartley and Reilly, both of whom had been

gold miners in California, set out in the month of February on a prospecting tour up the Molyneux River. They found the gold so easily obtained that, in their own words, "they had nothing to do but to set the cradle at the edge of the river, and keep it going from morning to night, as one man could get rich wash-dirt to feed the cradle as fast as the other could wash it." They brought to Dunedin, as the result of three months' labor, 87 pounds weight of gold, and received from the Provincial Government £2000 as a bonus for making known the locality of their discovery.

In the latter part of 1862 and beginning of 1863, large additions were made to the goldfields of Otago. In the early part of 1863 rich discoveries on the Wakatipu Lake and its tributaries were revealed, some of the streams yielding a fabulous amount of gold, and immense areas of auriferous ground were opened up. In the latter end of 1863 further and brilliant discoveries were made on the West Coast of Nelson, and in the early part of 1864 the Matakitaki Diggings, in the same province, showed considerable activity.

In April, 1864, gold was first discovered in the Province of Marlborough, in the River Wakamarina, and its neighbourhood. A large rush of population took place, and a considerable quantity of gold was procured. Disastrous floods, and the impenetrable nature of the country, however, hindered the progress of this goldfield, which is now all but deserted. During the same year, gold was obtained in the Teremakau River, on the West Coast of Canterbury, and at other places along the Coast.

The year 1865 ushered in a very important discovery of gold in the Hokitiki River, on the West Coast of Canterbury, which has been followed by a large rush of population. The yield of gold has, so far, been very considerable, and as further important discoveries have been made in the district, it is probable the Hokitiki will turn out a very rich and extensive Goldfield.

With reference to the general character of the Nelson Goldfields, Professor Hochstetter made the following remarks in a lecture he delivered on the subject:—

"In the mica-slate and clay-slate zone of the western ranges, we have the matrix of the gold. On the east these formations are bounded by the Takaka Valley; on the west by the Aorere Valley; so that its breadth is from fifteen to twenty miles, and includes the Anatoki and Haupiri Ranges. In a southerly direction the same formations can be traced to the gorge of the Buller River, and it is not unreasonable to infer that the

same gold-bearing zone may extend continuously throughout the length of the Middle Island. The gold in its original position is, in larger or smaller particles, dispersed throughout the quartzose constituents of the mica and clay-slate formations. By the gradual wearing away of these rocks, through the action of the elements extending over immense periods of time, large masses of *debris* have been formed, and itself has executed an operation of gold washing, by collecting the heavier particles and depositing them in the gullies of the streams, or in the conglomerates covering the slopes of the hills. There are, therefore, two principal descriptions of diggings—'river diggings,' in the beds of streams, and 'dry diggings' in the conglomerate and gravel accumulated on the slopes of the mountains."

Speaking of the Aorere and Parapara goldfield, Dr. Hochstetter says:—

"The gold in the Aorere Valley is confined to the eastern side of the valley; the only traces of gold on the western side are on the Kaituna stream, but not indicating any rich deposit on that side. All the tributaries of the Aorere River, proceeding from the Haupiri range, have been successfully worked. The whole region of the eastern side of the Aorere Valley rising from the river bed towards the steep sides of the mountains, and occupying, from the Clarke River towards the south, to the Parapara on the north, a superficial extent of about forty English miles,—is a good goldfield. Throughout the whole district on the foot of the range, we find a conglomerate deposited on the top of the slate rocks, reaching in some places a thickness of twenty feet. Pieces of drift-wood changed into brown coal, indicate a probable tertiary age of this conglomerate formation. The conglomerate formation is not only cut through by the deep gullies of the large streams, but in some places washed by the more superficial action of occasional water, and so divided into parallel and rounded ridges. This conglomerate formation must be regarded as the real goldfield.

"Estimating the superficial extent of the Aorere and Parapara goldfields at thirty square miles; the average thickness of the gold-bearing conglomerate, at a very low rate—one yard; and the value of the gold in one cubic yard at 5s.:—the value of the Aorere goldfield is £22,500,00C."

With regard to the Geological features of the Otago goldfields, the following particulars are extracted from a Report recently made by Dr. Hector, the Director of the Geological Survey of New Zealand:—

"The crystalline rocks, which occupy one-fourth of the area of the Province, or about 4500 square miles, lie along the western seaboard, between Milford Sound and the West Cape, and extend eastward as far as the depression made by the Te Anau Lake. They consist of a great variety of granites, gneiss, and porphyritic rocks, that form massive mountains 4000 to 7000 feet in height.

"Although the gold-bearing rocks, which belong to a newer formation, have undoubtedly been denuded from the surface of this area—and though patches of them may still be found resting on these crystalline rocks, yet from the absence of the finely assorted '*drifts*,' which are so characteristic of the eastern part of the Province, profitable gold-mining can hardly be expected in any part of this area. The only drifts that are met with are those deposited by torrents, the irregular action of which will always render the search for gold deposited through their agency a matter of mere chance.

"Schistoze formations, from which the gold is principally derived, occupy nearly half the area of the Province, or about 8900 square miles. They form a broad axis which trends in a N.W. direction, having a width of 60 or 70 miles. These rocks vary much in composition, according to the degree to which their sedimentary origin has been obliterated, ranging from true mica slates to indurated sandstones and shales. There is a very distinctive feature of this formation as compared with the crystalline rocks, it being rare, unless when the schist is highly impregnated with quartz, to find it obtruding at the surface. On the surface of this formation occur extensive basin-like valleys, that appear at one time to have formed a series of lakes in which the detritus of the surrounding rocks accumulated. The water of these lakes having escaped, they are now represented by extensive grassy plains, surrounded by terraces.

"The palæozoic and secondary rocks which surround the auriferous schists have been grouped together, for although of a very different geological age, the form of surface to which they give rise is very similar, as both consist of highly inclined strata of sandstones and shale, that form sharp lofty ridges intersected by deep ravines. The palæozoic rocks occasionally contain beds of limestone, while the secondary rocks are characterised by the presence of thin beds of coal.

"The tertiary and volcanic rocks form a narrow belt along the eastern seaboard of the Province, extending up the larger valleys thirty or forty miles into the interior, and occupying an area of about 3,300 square miles. These rocks embrace limestones, sandstones, and clays of marine

origin, resting on extensive deposits of brown coal, and overlaid by volcanic rocks which were emitted towards the close of the tertiary epoch. This area includes several of the goldfields of the Province.

"The indications of a rich goldfield are not mainly derived from the presence of auriferous rocks, but from the occurrence of large deposits in the *debris* (or 'drifts') of these rocks, and the degree of concentration that this *debris* has been subjected to by the action of running water. These auriferous drifts are, however, so universally distributed, and their existence is so rarely ascertained until workings are actually commenced, that it would be safe to assume their presence in any district where the auriferous rocks prevail."

In a Report made by Dr. Hector, and published in the Otago *Government Gazette*, Vol. V., page 81, September 3rd, 1862, the causes which have led to the distribution of the auriferous drifts in the valleys of the interior are clearly described. He selects for this description the great basin embracing the Upper Taieri Plains, Idaburn Valley, and the Manuherikia Valley, which is enclosed by a succession of parallel ridges, composed of highly altered sedimentary rocks, impregnated with quartz. This great basin has only two outlets for its drainage—one by the gorge of the Taieri River, and the other by the gorge of the Molyneux. In both these cases the drainage escapes by a channel which has been, so to speak, cut through the rocky lip of the basin. Dr. Hector then proceeds to say—

"Bearing in mind the now well established fact that after the original wearing down of the rocky matrix, the mechanical liberation of its contained gold, has been effected for the most part by long continued wave and current action, either in the sea, or large inland lakes, and that the comparatively feeble and limited action of streams has merely exerted an ever-recurring sifting and sorting influence on the materials thus prepared, we can at once perceive that in this rock-bound basin the conditions have been most favorable for retaining and assorting the *debris* formed by the degradation of the surrounding schists during the submergence of the land in tertiary times. The floor of this basin is now occupied by extensive grassy plains, sometimes presenting a wide expanse of many thousand acres in extent, but always terraced and beautifully moulded towards the margin by the action of the retiring waters, as the drainage channels were slowly cut by the two rivers before-mentioned."

Dr. Hector is confirmed in his opinion that this extensive degradation of materials is due to river and lake action, by the fact that round the

margin of the basin, and resting on the flanks of the schist ranges, remnants of tertiary strata are to be found to the height of 1000 feet above its lowest present level, or 1600 feet above the level of the sea, the thickness of which agrees well with that of the tertiary strata in other parts of the Province.

Within this basin, from the different class of agencies which have been at work, are two distinct groups of deposits, which Dr. Hector designates the *older tertiaries* and the *newer tertiaries*. "The older tertiaries are the deposits which gradually filled up the depression as it passed through the successive stages of submergence, from an estuary-like arm of the sea to a deeply excavated submarine valley." The earliest formed of these strata, which can only be seen in a few localities, invariably consist at the base, where they rest on the schist, of strata indicative of the neighborhood of dry land at the period of their formation, supporting a vigorous vegetation, which has been preserved to the present day as *brown coal*, associated with finely-assorted beds of clay and gravel. In the clay marls associated with the brown coal beds of this district marine shells have been recently discovered.

"Over this group," says Dr. Hector, "have been deposited strata of sand and conglomerate, formed of materials derived from the schistoze rocks. The upper portion of this deposit, which is many hundred feet in thickness, consists purely of fragments of quartz. In some cases these upper quartz pebble beds have been firmly cemented by some process not yet clearly understood, into a hard resisting rock, which breaks up into huge cubical fragments, that are to be found scattered over slopes from which the underlying strata have been removed, or are found capping hills of these strata, which have been preserved. Such hills are the 'white made-hills' of the gold-miner. They are undisturbed outliers of the older tertiaries, and when they rest on a depression in the schistoze rocks, and at a considerable altitude, *they often prove very rich in gold*, having been formed during the period of greater depression, when the current action would manifestly be most intense."

Indications of "made-hills" are prevalent throughout this district, and have been favorably tested by mining operations. In some districts of the Province exist basaltic-capped hills, which often cover rich auriferous drift. These were formed by volcanic eruptions, which marked the period of the greatest depression of land, corresponding with the close of what Dr. Hector terms the "older tertiary epoch." The "newer tertiaries" owe their origin to the degradation of pre-existing strata

which accompanied the elevation of the land by volcanic activity.—"During this period," says Dr. Hector, "the rock-bound basin afterwards to be drained by the Taieri and Molyneux Rivers, became converted into a system of lakes, connected by streams, which slowly excavated terraces, and deposited in a more perfectly assorted form the materials which composed the plateau. In the lakes, the sorting process would be still more perfectly accomplished, the coarser materials being deposited at the inlet, while the finer sediment would only settle in deeper water, or towards the outlet. The Taieri Lake is the last remnant of this once great expanse of fresh water, but the materials which were deposited in this manner still exist, forming terraces and cliffs of shingle, gravel, clay and fine loam. As the main exit channels of the basin were deepened, the lakes were in time drained, and their materials again assorted by the corrosion of the streams. This sorting process, which may justly be compared to the action of a sluice in ordinary gold-washing, has been continuously in operation during the lapse of vast ages, sifting and separating, according to the specific gravity of its component parts, the *debris* of the schistoze rocks, and preparing the way for the gold-miner by concentrating the precious metal in a smaller and smaller quantity of *wash-gravel*. Gold being the heaviest material contained in these deposits, must be looked for as a residuum remaining behind after the lighter parts of the schistoze *debris* have been removed by the action of water. When, therefore, it is found on the bars or in old channels of a stream, one must look to the detritus, or drifts, in the neighborhood as its immediate source; and the more they bear signs of having been well sorted, the probability is increased of finding the heavier materials, and among these, the gold, gathered into leads towards the base."

Dr. Hector's opinions have been strikingly verified, particularly in respect to the district he indicated in his remarks, and the most profitable ground at present is that in the terraces and slopes of the great basin referred to. "Exactly similar deposits," says Dr. Hector, "occur in basins upon the western slope of the rocky mountains of North America, from an elevation of 5000 feet almost to the sea level, and extending from California northwards into British Columbia. The absence of basalt-topped hills, and the large scale on which the terraces have been developed, give the Manuherikia and Taieri plains a striking resemblance to the upper valleys of British Columbia."

Hill sluicing, Dr. Hector is of opinion, is the only form of gold-mining which will continue to yield steady results for many years to come; and

from the increasing extensiveness of the mining operations of this character it may be inferred that the practical miners are of the same opinion. And so favorable have been the results of this branch of mining, and so immense is the extent of workable ground, that it may be fairly anticipated the Province of Otago will be a large gold-producing country for a long period of time to come.

River working is profitably followed in various portions of the Province, more particularly in the Wakatipu district, and in the beds of the Molyneux and Manuherikia rivers. As these deposits become exhausted, further attention will be given to the drift formations. Quartz-mining is as yet in its infancy in Otago, but several promising reefs have been opened, which are expected to prove rich. The most important quartz-workings are at Waipori.

The following statistics concerning the gold production of New Zealand are compiled from official sources:—

YIELD OF THE OTAGO GOLDFIELDS.

QUANTITY BROUGHT DOWN BY ESCORT.

	OZS.	DWTS.
1861	203,483	0
1862	331,633	12
1863	565,661	1
1864	394,064	2
Total, ...	1,494,841	15

QUANTITY EXPORTED.

	OZS.	DWTS.	GRS.
1861—1862, 1st August to 31st July, ...	457,239	10	6
1862—1863, do. do., ...	514,385	17	0
1863—1864, do. do., ...	497,031	9	0
1864—1865, 1st August to 31st March, ...	231,010	11	0
Total quantity exported from Otago,	1,699,667	7	6

In addition to the above, 63,970 ounces of gold, the produce of the goldfields of Otago, have been exported from other ports in New Zealand, making the grand total exported 1,763,637 ozs. 7 dwts. 6 grs., value £7,054,544.

MINING MACHINERY.

Systematic mining by the aid of appropriate machinery has almost entirely superseded the partial and careless surface digging which prevailed in the earlier days of the gold discoveries. The greater proportion of the permanent works and machinery has been created within the last two years, and it is a noteworthy fact that much of it is established on fields which have been abandoned by the surface-miner as unprofitable, but which under the new order of things is giving remunerative employment to those engaged on them.

From Table A,* it will be observed that by far the largest proportion of the total approximate value of mining machinery is represented by water races, of which no less than 1,311¾ miles are in existence, valued at £137,021.

Table B,* shows the proportion of miners engaged in the various descriptions of mining, on the Otago goldfields.

The exhibits of Gold included the following:—

AUCKLAND.—Specimens of auriferous quartz from Coromandel, exhibited by the Golden Point Mining Co.—Section of a nugget from Coromandel, and specimens of auriferous quartz, exhibited by the Auckland Local Committee.

WELLINGTON.—A small bottle containing gold, found at Terawiti, exhibited by Nathaniel Grace.

CANTERBURY.—Specimens of gold in the geological collection of Dr. v. Haast.

OTAGO.—Eighty cases containing washdirt from the various goldfields of the Province, collected by the Mining Surveyors and Wardens.—A collection of specimens from the various quartz reefs of the Province, exhibited by the Secretary to the Goldfields Department, including the following:—

A quartz pebble from the Arrow River, being a rolled fragment of sub-crystalline milk quartz filled with bright crystalline gold.

Auriferous quartz from Skipper's Gully, blue quartz breccia, with gold disseminated in sub-crystalline scales.

A boulder of blue brecciated quartz, probably a cement, speckled with gold,—from Prospectors' Claim, Butcher's Gully, Manuherikia District.

A boulder of ferruginous quartz from Woolshed Creek, Glenmore, speckled with fine scales of gold.

Specimen of ferruginous quartz full of small cavities, from Black's Reef, Manuherikia; looks good quartz, but no gold visible.

* The Tables are printed at the end of the Report on Class I.

Specimen of quartz from the Arrow Reef; seems to be a brecciated reef marking a line of fissure. The quartz is sub-crystalline, intermixed with fragments of schist.

Samples of quartz from Dunstan; Elgin Reef, Upper Shotover; Serpentine Reef, Upper Taieri—(highly crystalline, gold visible); Adelaide Reef, Hindon; Prospector's Reef, Frazer's Gully, Taieri (reef 3 feet thick); Blacksmith's Gully, and Highlay Reef.

Specimens of auriferous quartz from the Pioneer Reef, Waipori—the most extensive quartz workings in Otago.

The Bank of New Zealand, the Bank of New South Wales, and the Union Bank of Australia exhibited samples of gold from the various goldfields of Otago,—including specimens from Marlborough, Nelson, and the West Coast of Canterbury. A most attractive feature of these collections was formed by several very large nuggets from the Buller River, Lyell's Creek, and other diggings.

The Queenstown District Committee exhibited specimens of auriferous quartz from Skipper's Gully, Shotover, and Arrow.

In the Museum collection of Dr. Hector were specimens of native gold (nearly pure) from Moeraki, where it is found intermixed in very fine particles in the sand on the beach; Gold alloyed with silver, found imbedded as grains in Cinnabar; Gold alloyed with copper, found in auriferous drifts.

The Rev. E. G. Edwards exhibited a specimen of the auriferous cement from the Hamilton Diggings. The gold is visibly intermixed with the cement.

Table C,* shows the assay of the gold from the various goldfields, as furnished from the assay offices of three Banks in Otago.

IRON.

Iron is exceedingly common in various parts of the Colony, in the form of magnetic iron sand. Deposits of this iron sand are most frequent on the Western Coast of the North Island, and on the Eastern Coast of the Middle Island; and in the sands of many of the streams it is also found in great quantity. At New Plymouth, this magnetic sand covers the shore for miles. It consists of the peroxyde and protoxyde of iron mixed, and yields from thirty-eight to fifty per cent. of iron of the finest quality. Attempts have at various times been made to utilise this sand, and small quantities have been sent to England, where it has been manufactured into steel and cutlery. Up to the present time, however,

* At the end of this Report.

nothing of any importance has been accomplished in the way of practically developing the material. A box full of this sand was exhibited, as well as specimens of cutlery manufactured from it.

Specimens of iron-sand were exhibited in the collection of the Gold-fields Department of Otago,—comprising black magnetic iron-sand, titaniferous sand, rhodonite or silicate of manganese and iron. Full particulars relating to these and other iron sands will be found in the Appendix to these Reports.

Clay iron ore, carbonate of iron, and red hematite, are also found in considerable quantities in the Colony.

Specimens of earthy carbonate of iron were exhibited in the Auckland Department; and samples of clay iron ore, and carbonate of iron, were shown in Dr. Haast's collection—the latter being found in large boulders, coated with black psilomelane, near the sources of the river Kowai, Mount Torlesse. Iron pyrites, or di-sulphide of iron, is found in very large cubes in the chloride schist at Maori Point, Shotover. Magnetic oxide of iron is found in Otago as black sand, and rolled fragments in the alluvial drifts, as crystals and masses imbedded in the chloride schist, and gneiss, and other metamorphic rocks, and also large veins on the Shotover River and on the West Coast. Peroxyde of iron is found as veins in the crystalline rocks and schists near the Otago Lakes, Shotover; and silicate of iron in certain schists, and in the green-sands of the middle tertiary series, as glauconic grains.

SILVER.

This metal has only been, as yet, discovered in small quantities in New Zealand, and generally alloyed with other metals.

A small specimen of gold alloyed with silver, was exhibited by the Auckland Local Committee.

Samples of Nelson silver, in bar and powder, were exhibited by Mr. T. W. Tatton, of Nelson.

Silver was discovered near the head of the Wakatipu Lake, in the Province of Otago, by Mr. J. B. Bradshaw, in 1864. It was shortly afterwards met with at Skipper's Gully, mixed with the auriferous drifts, of which specimens were shown in the Exhibition.

LEAD.

Lead has been found in the Provinces of Nelson and Otago.

Samples of Nelson lead were exhibited by T. W. Tatton. As yet it has only been found as rolled fragments, which consist in part of quartz.

MERCURY.

Mercury has been discovered in Otago in the form of cinnabar, or sulphide of mercury, in the alluvial deposits on the Obelisk Ranges, at Potter's Gully, Dunstan, Serpentine Valley, and Waipori.

A specimen of this cinnabar was exhibited in the Museum collection of Dr. Hector. As yet it has not been found *in situ*.

BUILDING STONE.

Excellent building stone is found in every part of the Colony of New Zealand. A detailed description of the various stones will be found in the Appendix to these Reports.

Granite of very superior quality is found on the west coast of Otago, and syenite, and other crystalline rocks at the Bluff. The New Zealand exhibits were as follows:—

AUCKLAND.—Freestone from the Bay of Islands and Motupipi; and excellent scoria stone from Mount Eden, exhibited by the Superintendent of Auckland.—Limestone and sandstone, exhibited by George Cole, Papakura.—Limestone, exhibited by Thomas Ball, Monganui.

HAWKE'S BAY.—Fossil limestone from Portland Island, exhibited by Whitmore and M'Neil.

NELSON.—Flagstone and limestone from the Dun Mountains, exhibited by the Dun Mountain Company.

CANTERBURY.—Canterbury exhibited a large number of fine samples of excellent building stone. W. G. Brittan exhibited specimens of building stone from the Halswell quarries, seven miles from Christchurch. This stone is extensively used for rubble-walling. The Council Hall and Wesleyan Church, Christchurch, are built of it.—Chalmers and Hall send specimens of stone from the Crighton Dale quarry, Lyttelton. It is procured easily, in lengths of six feet, and is well suited for kerbing. The price quoted by the exhibitors is 3s. per foot cube, delivered in port.—N. and A. Ellis exhibited a turned and polished column 5ft. 6in. long, and several cubes of stone from the Greystone quarries, Banks' Peninsula. This stone exists in abundance in dykes about 17ft. wide, and is used for ashlar work of all kinds. It is durable, and is delivered at the quarry at 2s. 6d. per foot cube. The size at which blocks can be most readily procured, is from one to fifteen cubic feet. It is possible to get blocks containing 200 cubic feet.—Forgan and Son send samples of excellent limestone, obtained at the Weka Pass, northern district of Canterbury, where it exists in unlimited quantity, and can be got in blocks of almost any size. Price at the quarry, 1s. per cube foot.—

Graham and Weybourne exhibit two cubes of freestone, from Governor's Bay, Lyttelton. Price at the quarry, from 1s. 9d. to 2s. per foot cube. The same exhibitors send also two cubes of greystone, from a quarry near Lyttelton. It is a good stone to work, and costs at the quarry 1s. 6d. per foot cube.—Hall Bros. send two blocks each, of two varieties of stone, from Governor's Bay. It can be shipped on board at two shillings per foot, and can be procured in blocks 18ft. x 14ft. x 3ft., or larger.—F. Thompson sends twelve blocks of stone, of four varieties, from Bridle-path quarry, Heathcote Valley, near Christchurch. This quarry has been extensively worked since 1863. The stone forms a vertical dyke or reef, about 20ft. in thickness, which appears to extend in a straight direction for several miles. At Mr. Thompson's quarry, the reef rises out of the steep hill like a wall, to the height of 30ft. Blocks of any size, up to 15ft. in length, can be obtained.

OTAGO.—Specimens of excellent limestone and marble from Shag Valley and Oamaru districts are exhibited by Mr. D. Hutchinson.—The Moeraki District Committee exhibit five blocks of excellent building stone. —H. Ridley, Portobello Bay, near Dunedin, shows samples of building stone of good quality from that district.—The Waikouaiti District Committee send some excellent specimens of freestone from Mount Cornish and Pleasant River; also, three blocks of grey marble.—The Port Chalmers District Committee exhibit a pedestal made of Port Chalmers stone, which is a tough volcanic breccia.—The Oamaru District Committee send specimens of flagstone, bluestone, and freestone, found in the neighborhood. The freestone is abundant and soft to work, and stands exposure well. It is delivered at the quarry at 7d. per cubic foot.

The Museum collection of Dr. Hector contains specimens of a great variety of stones and other rocks, suitable for building, sculpture, and road-making, viz.:—

BUILDING STONES.

Trachytic porphyry	Portobello.
Porphyry, or trachydolorite ...	Flagstaff Hill.
Do. ...	Water of Leith.
Clinkstone, columnar ...	Bell Hill.
Do., laminated ...	Blanket Bay.
Vesicular basalt	Kaikorai.
Porphyritic	Pine Hill.
Dolorite	Kaikorai.
Trachytic porphyry	Tairoa Heads.

Trachytic porphyry ...	...	Moeraki.
Basaltic conglomerate	...	Port Chalmers.
Aphanite do.	...	Dog Island.
Syenite	...	Do.
Do.	...	The Bluff.
Sandstones ...	...	Moeraki.
" ...	...	Waikawa.
" ...	...	Arden's Bay.
Claystones ...	...	Saddle Hill.
" ...	...	Moeraki.
" ...	...	Mount Pleasant.
" ...	...	Anderson's Bay.
Calcareous sandstones	...	Kaikorai.
" ...	...	Caversham.
" ...	...	Hawkesbury.
" ...	...	Pleasant River.
" ...	...	Waiheimo.

LIMESTONES.

Subcrystalline compact (marble)		Blue Mountains, Shag Valley.
Compact fossiliferous	...	Wakatipu Lake.
Crystalline limestone ...	...	Oamaru.
Do. fossiliferous	...	"
Compact	...	"
Lithographic ...	...	"
Compact granular ...	...	"
Conglomeritic ...	...	"
Compact	...	Mount Royal.

SCHIST.

Chloritic metamorphosed	...	Cromwell.

CRYSTALLINE ROCKS.

Syenite	...	Dog Island.
Do.	...	The Bluff.
Granites	...	West Coast.
Do. with Garnets ...	...	Metal Mountain, do.

SOUTHLAND.—Samples of Limestone were exhibited by C. Basstian, Aparima; and J. Hill, Winton. This stone is used extensively in the district, and is supplied at 1s. per foot at the quarry.

TASMANIA.—Very beautiful building stone of superior quality exists

in great abundance in this Colony, which was well represented in the Exhibition. John Gillon, Hobart Town, exhibits specimens of stone from Kangaroo Point, and a grindstone from the same quarry. Also, a specimen of hydraulic limestone from Mount Wellington.—John Gowland, Hobart Town, sends specimens of white and brown stone of superior quality from Bridgewater, on the Derwent.—O. H. Hedberg, Hobart Town, exhibits a specimen of grey granite from Port Seymour, where it is procurable in large quantity.—G. Whiting, Hobart Town, sends a specimen of black and white marble, obtained in large masses about Chudleigh, near Deloraine.—A. M. Nicol sends cubes of white freestone from a quarry at Cambridge, which can be supplied in any quantity at 2s. per foot cube at the water side.—F. R. Chesner, Hobart Town, exhibits two specimens of excellent freestone from Woodstock Estate.

SOUTH AUSTRALIA.—J. Kellet, Adelaide, exhibits 3 slabs of crystalline marble, and 2 tombstones of the same, for which purpose it is well adapted. The marble is white and veined with brown and yellow shades.

PLUMBAGO.

This useful mineral has only yet been found in quantity in the Province of Nelson, at Pakawau, on the shores of Golden Bay, where it occurs in thick beds interstratified with metamorphosed shale.

Specimens, from the Pakawau mine, both crude and compressed, are exhibited by Mr C. Weisenhavern. The latter samples are found to be quite equal in colour and brilliancy to that commonly sold in paper packets for domestic purposes. For analysis *vide* Appendix.

As a mineral it has also been found to occur in scales in the granular marble of the West Coast of Otago, and in some of the metamorphic schists, specimens of which were exhibited in the Otago Museum by Dr. Hector.

SULPHUR.

In the Auckland department some remarkably fine specimens of crystallised sulphur are exhibited. Sulphur exists in immense quantity at White Island—a volcanic island on the East Coast, in the Bay of Plenty. Near the centre of the island is an enormous boiling spring, 100 yards in circumference, and innumerable small geysers. The surface of the island is quite hot, and covered with sulphur. Sulphur is also found in quantity at the Hot Lakes, near Taupo. No attempt has yet been made to turn these deposits to commercial account, although there cannot be a doubt that at some day they will prove of great value.

ALUM.

Alum is formed naturally wherever pyritous shales are exposed to the atmosphere, and from Waikouaiti, in the Province of Otago, specimens of it, crude and crystallised, were exhibited by the Waikouaiti Local Committee.

GYPSUM.

This valuable material is found in various parts of the Colony. Specimens were exhibited in the Museum collection of Dr. Hector, from Moeraki, where it is found crystallised in clay; and also in quantity, and manufactured into plaster of Paris, by the Waikouaiti Local Committee.

MISCELLANEOUS.

Specimens of the undermentioned substances were also exhibited:—

Pumice Stone—From the beach near Napier, where it is found in considerable quantity, washed down by the rivers from the North.

Asbestos—From Milford Sound, on the West Coast of Otago.

Kaolin—From the Whau, Auckland; and from the Manuherikia Plains and Arrow River, Otago.

Scheelite—Common in the gravel of the Rees River, Wakatipu Lake. From this mineral, which is Tungstate of Lime, a variety of useful preparations are made, viz., pigments, mordants, and other materials. Examples of these, manufactured from the scheelite obtained from the neighborhood of the Wakatipu Lake, were exhibited by Mr. Skey, the Analytical Chemist of the Geological Survey of New Zealand.

Manganese—Specimens of the Oxyde and Silicate of Manganese, found in the schist and alluvial drifts at the Kawarau and Clutha, were exhibited in the Museum collection of Dr. Hector. From these ores valuable preparations used in various processes of dyeing, are manufactured, examples of which were shown by Mr. Skey.

W. H. HARRISON.

HONORARY CERTIFICATES.

1. HIS HONOR THE SUPERINTENDENT, Auckland.—Coal and building stone from the Bay of Islands.

107. SAMUEL LOCKE, Hawke's Bay.—Stone from Ruahine Mountains.

301. PROVINCIAL GOVERNMENT, Nelson.—Coal from Buller River.

303. JOHN ROCHFORT, Nelson.—West Coast minerals and ferns.

304. DUN MOUNTAIN COMPANY, Nelson.—Chrome and other minerals from Dun Mountain.

307. T. W. TATTON, Nelson.—Pigments, &c., from chrome.
333. W. WEISENHAVERN, Nelson.—Plumbago from Pakawau mine.
403. N. & A. ELLIS, Christchurch.—Building stone from Greystone quarry.
401. W. G. BRITTAN, Christchurch.—Building stone from Haswell quarry.
402. CHALMERS & HALL, Christchurch.—Building stone from Crightondale quarry.
404. FORGAN & SON, Christchurch.—Limestone from Weka Pass.
405–6. GRAHAM & WEYBOURNE, Lyttelton.—Grey and freestone of excellent quality.
407. HALL BROTHERS, Lyttelton.—Building stone from Mr. P. W. Hodgson's quarries.
409. F. THOMPSON, Christchurch.—Excellent building stone from Bridle Path quarry.
501. SECRETARY TO GOLDFIELDS DEPARTMENT, Dunedin.—Valuable collection of mineral specimens.
503. BANK OF NEW ZEALAND, Dunedin.—Samples of gold from the various N. Z. goldfields.
504. BANK OF NEW SOUTH WALES, Dunedin.—Samples of gold from the various N. Z. goldfields.
1065. UNION BANK OF AUSTRALIA, Dunedin.—Samples of gold from the various N. Z. goldfields.
505. D. HUTCHISON, Shag Point.—Excellent building stone—marble, coal and lime,—Shag Valley.
507. J. & G. LEWIS, Clutha.—Coal from the Clutha.
1063. HUGH CALDER, Caversham.—Building stone from Caversham.
1064. LANARKSHIRE COAL COMPANY, Green Island.—Coal from Green Island.
1202. C. BASSTIAN, Aparima.—Limestone and lime.
1205. J. HILL, Winton.—Lime from Winton district.
2801. J. GILLON, Hobart Town.—Excellent building stone from Kangaroo Point.
2806. A. M. NICOL, Hobart Town.—Excellent white freestone from Cambridge.
2807. F. R. CHESNER, Hobart Town.—Excellent white freestone from Woodstock.
2401. MOREHEAD & YOUNG, Newcastle, N. S. W.—Coal of superior quality.
2402. NEWCASTLE WALLSEND COAL COMPANY, Newcastle, N. S. W.—Coal of superior quality.
2403. WARATAH COAL COMPANY, Newcastle, N. S. W.—Coal of superior quality.
2421. J. KELLET, Adelaide, S.A.—Marble of excellent quality, and tombstones made from it.

TABLE A.

***THE FOLLOWING PARTICULARS** of the various descriptions and total approximate value of Mining Machinery employed on the various Goldfields are compiled from the Official Returns of the Government Mining Surveyors, dated the 31st March,* 1865.

	CRADLES.		PUDDLING MACHINES.		HYDRAULIC HOSE.		SLUICE BOXES AND TOMS.		WATER WHEELS.		PUMPS.		DREDGING MACHINES.		OTHER KINDS OF MACHINERY		WATER RACES.		QUARTZ-MINING.				TOTAL APPROXIMATE VALUE.
	No.	Value.	No.	Value.	No.	Value.	No.	Value.	No	Value	No	Value.	No.	Value.	No.	Value.	Length Miles.	Value.	No. of Stamps.	Horse-power.	Description.	Value.	
		£				£				£		£				£		£				£	£
Tuapeka Goldfields	5	15	...	...	1	2	1432	4864	70	700	125	334	...	...	...	...	543¼	32535	10	16	Overshot-wheel	1200	39659
Dunstan proper ...	17	25	...	...	12	84	203	393	31	427	53	335	6	345	...	1036	184	12610	..	...	...	...	15255
Upper Dunstan ...	18	26	...	...	13	90	99	167	8	141	21	110	2	82	...	612	123½	6220	...	...	...	...	7448
Upper Manuherikia	109	162	1	25	5	37	111	192	...	...	33	156	...	...	...	1988	103	20440	...	...	...	...	23000
Mount Benger ...	36	57	...	...	...	...	198	235	12	119	40	189	2	140	...	820	100	11418	...	...	...	...	12978
Wakatipu District	333	1129	...	...	33	1190	508	1615	68	13100	358	7704	...	...	...	...	140	40900		12	Cornish stamps	710	66348
Mount Ida and West Taieri Goldfields	261	657	2	70	...	...	150	401	...	...	...	...	...	...	...	...	118	12898	24	78	...	...	14026
																					Total Value		£178,705

TABLE B.

CONDENSED FROM OFFICIAL SOURCES, showing the Proportion of Miners engaged in the various descriptions of Mining on the Otago Gold Fields.

LOCALITIES.	Cradling.	Sluicing.	Ground Sluicing.	Using Hydraulic Hose.	Puddling.	Dredging.	Tunnelling.	Quartz Mining.	Other descriptions of Gold Mining.	Total Number of Miners.
Gabriel's District... ...	...	735	327	...	...	...	12	...	...	1,074
Waipori do.	...	379	...	...	...	...	...	26	...	405
Waitahuna do.	4	287	45	...	...	...	...	...	...	336
Woolshed do.	...	130	...	...	...	...	6	...	...	136
Mount Ida & Wt. Taieri	780	...	595	...	10	...	...	...	...	1,385
Wakatipu District ...	8	618	185	48	...	...	135	15	220	1,229
Dunstan proper	44	426	109	53	...	28	31	...	8	699
Upper Dunstan	45	167	112	58	...	4	15	...	9	410
Manuherikia	323	346	391	8	95	...	...	4	78	1,245
Mount Benger	82	372	38	...	...	12	...	...	44	548
Totals	1286	3460	1802	167	105	44	199	45	359	7,467

These figures were returned at a period when the population had been much diminished by the rush to the Canterbury West Coast Diggings.

TABLE C.

***ASSAY REPORTS ON NEW ZEALAND GOLD**, as furnished by the Union Bank of Australia, the Bank of New Zealand, and the Bank of New South Wales, Dunedin.*

DISTRICT.	AVERAGE LOSS IN MELTING.				ASSAY.				EQUIVALENT OF ONE OUNCE OF GOLD IN STANDARD GOLD.			
	U.B.A.	B.N.Z.	B.N.S.W.	Average	U.B.A.	B.N.Z.	B.N.S.W.	Average.	U.B.A.	B.N.Z.	B.N.S.W.	Average.
					c. gr 8th	c. gr. 8th	c. gr. 8th	c. grs 8th	oz dwt gr	oz. dwt gr	oz. dwt gr	oz dwt gr
Dunstan	2.868	3.000	3.5	3.122	22 3 7	23 2 0	23 1 0	23 0 7	1 0 19	1 0 23	1 0 22	1 0 21⅓
Dunstan Creek, Blackstone's Hill	3.065	3.638	4.0	3.567	23 0 7	23 1 7	23 1 7	23 1 4	1 1 2	1 1 8	1 1 8	1 1 6
Wetherstone	4.318	4,218	3.4	3.948	23 0 6	23 0 6	23 0 5	23 0 5	1 1 1	1 1 1	1 1 1	1 1 1
Waipori	4.408	4.232	3.6	4.080	23 0 7	23 0 4	23 1 0	23 0 6	1 1 0	1 1 0	1 1 8	1 1 1⅔
Manuherikia	2.902	3.105	2.6	2.869	23 0 2	23 0 6	23 0 2	23 0 3	1 0 23	1 1 1	1 0 23	1 0 23⅔
Hamilton	3.612	...	3.0	3.306	23 1 4	...	23 1 2	23 1 3	1 1 6	...	1 1 4	1 1 5
Mount Ida, (Hogburn)	3.876	3.330	3.2	3.468	23 1 7	23 1 5	23 1 6	23 1 6	1 1 8	1 1 6	1 1 7	1 1 7
Arrow River	2.269	2.732	2.4	2.467	22 3 5	22 3 5	22 3 5	22 3 5	1 0 20	1 0 20	1 0 2	1 0 20
Queenstown	2.495	2.105	2.3	2.300	22 3 0	22 2 6	22 2 2	22 2 5	1 0 17	1 0 15	1 0 12	1 0 14⅔
Waitahuna	3.475	3.646	...	3.560	23 1 7	23 1 0	...	23 1 3	1 0 10	1 1 3	...	1 1 6½
Nokomai	3.198	3.615	...	3.406	22 1 3	22 2 0	...	22 1 5	1 0 7	1 0 11	...	1 0 9
Tuapeka	4.138	4.108	...	4.120	23 0 4	23 0 5	...	23 0 4	1 1 0	1 1 1	...	1 1 0½
Lammerlaw	4.105	3.965	...	4.045	23 1 1	22 1 0	...	23 1 0	1 1 4	1 1 3	...	1 1 3½
Moeraki Beach	4.486	4.326	...	4.406	23 0 3	23 0 3	...	23 0 3	1 1 0	1 1 0	...	1 1 0
Hyde	...	3.826	...	3.826	...	23 1 3	...	23 1 3	...	1 1 5	...	1 1 5
Charlston	...	2.950	...	2.950	...	22 3 0	...	22 3 0	...	1 0 17	...	1 0 17
Tokomairiro	...	4.528	...	4.530	...	23 0 2	..	23 0 2	...	1 0 23	...	1 0 23
Cromwell	...	...	2.4	2.4	...	...	22 3 5	22 3 5	...	...	1 0 20	1 0 20
Rough Ridge	3.105	...	...	3.105	23 0 6	...	...	23 0 6	1 1 1	...	...	1 1 1
Highlay	7.487	...	...	7.487	22 2 4	...	...	22 2 4	1 0 14	...	...	1 0 14
Wakamarina	4.535	...	...	4.553	22 3 2	...	...	22 3 2	1 0 18	...	...	1 0 18
Coromandel Quartz Gold	5.023	...	...	5.023	17 0 2	...	...	17 0 2	0 15 8	...	...	0 15 8

CLASS II.

CHEMICAL SUBSTANCES AND PRODUCTS, AND PHARMACEUTICAL PROCESSES.

JURORS.

T. R. HACKET.	T. W. KEMPTHORNE.

THE Exhibits in this Class consist of—

Preparations of Chrome and other metals,	T. W. TATTON, Nelson,	307.
Sundry Chemicals, &c., ...	" "	"
Drugs and Chemicals, ...	T. M. WILKINSON, Dunedin,	518.
Alum and Alum Shale, ...	DISTRICT COMMITTEE, Waikouaiti,	515.
Sundry Chemical Preparations, &c., ...	W. SKEY, Dunedin,	702.
Guano from Bird Island, ...	W. L. CROWTHER, Hobart Town,	2808.
Guano, Coral Queen, Green Island, ...	COMBES AND DALDY, Auckland,	15[illegible]

307.—The preparations exhibited by T. W. Tatton consist of 7 different combinations of chromic acid, manufactured from the chromic iron-ore, found in large quantities near Nelson, with one of the green sesqui-oxyde of chromium; also, a crucible containing the ore calcined with potash, illustrating the method pursued in the manufacture. The crystals of the bichromate are of a deep rich colour, and are very pure and well crystallized. The precipitates of chromate and bichromate of lead, lime, &c., and sesqui-oxyde of chromium, show the various colours and shades which can be therefrom produced. These preparations have been made on a sufficiently large scale to be of practical utility, and are used for painting.

The sample of Lead prepared from ore found near Nelson is dense, pliant, and of great tenacity.

The Chemical Solutions consist in spirits of nitre, sal volatile, and sulphuric ether. These are of good quality.

Ferri Ammon-Cit, and Ferri Citras cum Quina. Scales of the former salt are of a rich ruby colour, and of great brilliancy. The

lamellæ of the latter valuable tonic are also well developed, but no percentage of quinine is given or guaranteed.

Pepsine, a preparation having the constituents C 53, H 6·7, N 17·8, O 22·5, according to Bidder and Schmidt, and which has of late years come into extensive use as a medicament in cases of indigestion, is also represented as a Nelson manufacture, with several other useful preparations, all of which are produced from raw materials found in New Zealand, —several of the above being of value in a mercantile point of view, the remainder being used medicinally.

515.—Case, showing alum in its different stages of manufacture, prepared by W. C. Ancell, Waikouaiti. This exhibit by the Waikouaiti District Committee shows—

> 1. The rough alum shale, found near Waikouaiti. 2. Raw alum produced therefrom, in its two intermediate stages, technically called "flour." 3. The pure alum in large crystals. This finished article appears quite free from iron, and has the characteristic crystallisation and whiteness of the best alum.

Although the value of alum is not sufficiently high to encourage its manufacture for export, it is interesting to know that this important article could be procured in the country in case of a demand arising for home consumption.

702—731.—Series of chemical products, manufactured in the Laboratory of the Geological Survey, from Otago minerals, by W. Skey, viz. :—

> 702—714.—The various oxydes of Tungsten and Tungstic Acid, showing its different stages of oxydation, with several salts of the latter; these preparations being made from scheelite or tungstate of lime, a mineral found in considerable quantities in the Wakatipu district. Tungsten in its different combinations is extensively used both as a mordant and as a pigment. Some of the above preparations, however, are entirely new.
>
> 715—718.—Manganese as two distinct sulphates and in two acid states, showing the different degrees of oxydation of which this metal is capable. The ore from which these preparations were obtained is found in the Kawarau Gorge.
>
> 709—723.—Sesqui-oxyde of Chromium, Chromic Acid, and three salts of the same, prepared from ore obtained in the neighborhood of the Wakatipu Lake.
>
> 726.—Orpiment prepared from the arsenical pyrites from Waipori Reef, (used as a pigment).

727.—Sulphate of Copper prepared from ore found at Moke Creek, and extensively used as a preventive of smut in wheat.

724–5.—Tannate of Quinine—the tannic acid being derived from the well known Tutu plant, which, it is ascertained, contains tannic acid in large quantities.

730.—Flax gum.

731.—Paraffine oil, prepared from the Molyneux brown coal.

This series of chemical products reflects great credit on the exhibitor, and shows a variety of economically useful preparations obtainable from minerals and plants found in Otago. These articles being catalogued in Class 29, this Jury refrain from making any award, but cannot pass them without a meed of praise.

732.—Mr. Skey also exhibits a series of 9 samples, showing the action of a solution of caustic potash on different varieties of New Zealand coal. This test shows the degree to which the change from the ligneous or woody tissue to true coal has been effected. The rationale of this process being, that the ligneous matter in the coal is soluble in the strong caustic solution, whilst the perfectly metamorphosed coal is absolutely insoluble. The result is, that whilst samples of the Buller, Grey, and Pakawau coal of older geological formation, hardly give a colour to the liquid, the lignite of the newer formations is dissolved to a great extent, and forms a thick opaque fluid.

519.—Low and M'Gregor, Mararoa—"Solution to supersede tobacco for sheepwash." Of this a bottle-full is exhibited; but there being no description of the article, the Jury are not in a position to speak of its effectiveness.

518.—T. M. Wilkinson, Princes street, Dunedin—Drugs and chemicals, consisting of 41 samples of barks, gums, roots, &c., imported. Taking the whole case, the Jury are of opinion that each and every article is of great purity and excellence. The large show crystals of bichromate of potash, alum, and sulphate of copper, with the crystals of nitre, are as a group very instructive, demonstrating the difference in the crystallisation of these different salts.

2808.—Phosphatic guano from Dr. Crowther's establishment on Bird Island, the analysis of which as reported gives a range of 65 to 70 per cent. of phosphate of lime. This guano is much used in Victoria and Tasmania. It is obtainable in inexhaustible quantity, and is sold in Hobart Town at £8 per ton. It differs from the Peruvian on account of the greater quantity of the phosphatic salts contained in it, the Peruvian

having a larger proportion of ammonia and its compounds. The uses to which each of these is applicable are therefore quite different. The Peruvian acting principally as a stimulant to the first growth of the plant by supplying the ammonia, and would also be best applicable to grasses, sugar cane, and other plants where the seed or root is not made use of; whilst the Bird Island guano supplies the greatest quantity of the phosphorus which is required for the ear in the grain crop, and the bulb in root crop, without which mineral constituent being supplied either by the soil or by manure, the seed, fruit, or bulb cannot come to perfection. Thus in an orchard the Peruvian variety would be expected principally to stimulate the growth of the trees and leaves by means of its ammonia, whilst that of Bird Island would to a greater extent assist in the formation of the fruit. The difference in these two varieties of guano arises from the fact of the Peruvian being obtained on islands where there is no rainfall; the Bird Island guano being, on the contrary, the remains of a larger quantity of excrement, from which the soluble ammoniacal salts have been removed by the rain, which has thus left the nearly insoluble phosphatic salts as a residuum.—In short, the Peruvian is of greatest value in the first stages of the growth of plants, whilst the Bird Island guano exerts its greatest influence towards their maturity. In this respect its effects are nearly similar to those of burnt bones; and it contains about the same amount of phosphates.

HONORARY CERTIFICATES.

15. **COMBES & DALDY, Auckland.—Excellent guano from Coral Queen Island.**

807. **T. W. TATTON, Nelson.—Excellent chemical preparations.**

518. **T. M. WILKINSON, Dunedin.—Excellent chemical preparations.**

702. **W. SKEY, Dunedin.—Chemical preparations from various Colonial substances.**

2808. **W. L. CROWTHER, Hobart Town.—Excellent phosphatic guano from Bird Island.**

CLASS III.

SUBSTANCES USED FOR FOOD.

SUB-CLASS A.—AGRICULTURAL PRODUCE.

JURORS.

GEO. MATTHEWS. | THOS. RICHARDSON.
DAVID ANDREWS.

UNDOUBTEDLY the first and most important considerations in estimating the value of a country, for the purposes of colonisation, relate to its climate and soil, and its capacity for yielding those agricultural products which are necessary for sustaining its population. That New Zealand possesses in an eminent degree all the conditions, both of climate and soil, suited to the production of the most valuable fruits of the earth, needs no further evidence than the marked progress in Agriculture that has taken place during the few years of its existence as a British Colony. The rapid development of the agricultural resources of New Zealand, is one of the most satisfactory proofs that can be afforded of its prosperity. And when the many difficulties which beset the first occupants of the uncultivated land are taken into consideration, the rate of agricultural progress which has been already attained, will bear a favorable comparison with that achieved in any other British Colony. All the modern appliances of the farm are being called into requisition, and the rapid increase of population, with the consequent heightened demand for produce, is annually causing largely increased areas of wild land to be cultivated.

In 1858, the total area of land enclosed amounted to only 235,560 acres; whilst in 1864 it had increased to more than a million acres. In 1858, the extent of land under crop was only 141,008 acres; but in 1864 it amounted to 381,526 acres. Thus in six years the area of enclosed

land increased by 450 per cent.; and that of land under cultivation by more than 200 per cent. Turning to the cultivation of grain, we find that in 1858, 13,710 acres were under wheat, and 15,514 acres under barley and oats. In 1861, the acreage devoted to these cereals had increased to 29,531 acres of wheat, and 19,329 acres of barley and oats; whilst in 1864 the area was 25,513 acres of wheat, and 55,609 acres of barley and oats. In 1858, the Colony exported grain and flour to the value of £23,186; in 1859, £42,075; in 1860, £14,366; but gradually declining as population increased during the succeeding years, until, in 1863, the exports amounted to only £1160; and in 1864, £722. In addition to the above figures, there was exported during the years 1853 to 1857, inclusive, grain and flour to the value of £215,925; whilst from 1853 to 1864, inclusive, potatoes and onions were exported of the total value of £301,025. Of the capacity of New Zealand as a wheat-growing country, there can be no doubt. On the rich alluvial flats of the North Island, and on the fertile plains of the Middle Island, crops of wheat and other grain are grown, which vie in luxuriance with the highly-farmed corn-fields of Great Britain. Hitherto the cultivation of wheat has not been followed so extensively as that of other grain crops; although, as will be seen by a reference to the statistics accompanying this Report, a considerable area of land has been placed under wheat in Canterbury and Otago. In both these Provinces, and in Southland, there are large tracts of agricultural land, capable of producing as good crops, and as fine wheat as are to be met with in Great Britain. The yield of wheat per acre, in New Zealand, exceeds very considerably that of the other Australasian Colonies. Thirty to thirty-five bushels per acre may be taken as a fair average throughout the Colony, although much larger returns are by no means uncommon. Fifty to sixty bushels to the acre are frequently produced; and as high as seventy bushels have been obtained in Otago and Canterbury. One of the oldest farmers in the first-named Province (Mr. Shand, of East Taieri) reaped last season over fifty bushels to the acre, off 170 acres of land on the Taieri Plain. In the fine agricultural district of Oamaru, in Otago, yields equally great are quite common. This extreme prolificness appears almost impossible when compared with the yield in the other Australasian Colonies. The average yield of wheat per acre in England is 30 bushels; in Scotland, 26 bushels; in Ireland, 24 bushels*; and in America and Canada, about 25 bushels.

* M'Culloch's Dictionary of Commerce.

Mr. Archer, the Registrar-General of Victoria, gives the yield of wheat, for a period of twenty-five years ending 1863, as being $20\frac{2}{3}$ bushels per acre. Mr. Rolleston, the Registrar-General of New South Wales, reports that the yield of wheat in that Colony has ranged from $12\frac{1}{2}$ to $16\frac{1}{2}$ bushels in five years—1854 to 1858, both inclusive; the average being a trifle over 15 bushels per acre. The average yield for seven years in South Australia, is only 11 bushels 46lb. per acre; whilst in Tasmania the yield for five years averaged 18 bushels 31lbs. The following table, compiled by an eminent Australian statist,* gives the highest and lowest averages of the produce of wheat per acre in the colonies of Victoria, New South Wales, South Australia, and Tasmania, embracing the number of years specified in the fourth column of the table:—

TABLE A.

	HIGHEST.			LOWEST.			DATES OF TABLES.
		bush.	lbs.		bush.	lbs.	
Victoria	1853	20	36	1863	8	4	1839 to 1863
New South Wales ...	1856	16	33	1863	7	47	1854 to 1863
South Australia ...	1863	14	0	1859	9	38	1858 to 1863
Tasmania	1860	21	10	1859	17	36	1859 to 1863

The average yield of wheat in New Zealand may be set down at from thirty to thirty-five bushels to the acre.

Barley has not hitherto been extensively grown in New Zealand; but now that a large demand exists for it for malting purposes, the breadth of land devoted to this cereal is being increased. The Province of Nelson undoubtedly stands foremost among the New Zealand Provinces in the production of Barley; and the sample of the Norfolk Chevalier variety, exhibited by Mr. Charles Best (308) received the warmest commendations of the Jurors.

Otago and Canterbury are the great Oat-growing Provinces; the acreage of land devoted to this crop by these Provinces in 1864, being respectively 20,800, and 14,670 acres. Very heavy yields of this crop are obtained. Over ninety bushels per acre of black Tartarian oats have been reaped in Canterbury; and almost as large a yield has resulted on the Taieri and Tokomairiro Plains, in Otago. Forty-five bushels per acre is a

* Mr. Bennett; Balmain, N.S.W.

fair average yield. Maize can scarcely be considered a standard crop in New Zealand. It is only grown in small patches, chiefly by the Natives, in the warmest districts of the North Island.

Potatoes are nowhere produced finer in quality, nor in greater abundance than in New Zealand. They grow equally well in the light rich volcanic soil of Auckland as in the fertile alluvial soil of Otago. The yield varies from ten to twenty tons per acre; and higher results have been obtained in specially favorable soil. It is a fortunate thing that the disease which has played such havoc in Europe, has not yet made its appearance in New Zealand, for the potato is almost as necessary to the Maoris as it is to the Irish peasantry. The Natives are extensive cultivators of this esculent; whilst the importance of the potato crop to the New Zealand agriculturists may be gathered from the fact, that during the ten years from 1854 to 1863, both inclusive, the value of the potatoes and onions exported from the Colony amounted to £301,025.

New Zealand stands pre-eminent amongst the Australasian Colonies for the suitability of its soil and climate to the growth of cultivated Grasses. Auckland and Taranaki are celebrated for the luxuriance of their cultivated pastures. In the neighbourhood of Auckland there are meadows, which for luxuriance, are equal to anything to be seen on an English farm; whilst in every other Province artificial pastures constitute one of the most profitable branches of agriculture. Mr. Weld, the present Premier of New Zealand, in his useful pamphlet on New Zealand Sheep Farming says, that "there is a good deal of land in New Zealand which, when grassed and fenced, will keep eight sheep an acre all the year round, and be proportionately good for cattle." The annual increase in the breadth of land sown down in grass is very remarkable. In 1851 there were but 16,000 acres of land in cultivated grass, whilst in 1858, there were nearly 100,000 acres, and in 1864, over 271,400 acres.

Hops are grown successfully in the Province of Nelson; there being a rather extensive Hop ground near the City of Nelson. It was a matter of regret to the Jury that no samples of New Zealand Hops were exhibited. A small sample of Tasmanian Hops was shown, the quality however, not being first class.

With regard to the cultivation of Horticultural produce, it may be said that every description of garden produce grown in Great Britain, will flourish luxuriantly in New Zealand; whilst many things which in England require forcing and protection, will grow freely in the open air. In the North Island, and the Northern Provinces of the Middle Island,

cucumbers, melons, and pumpkins, grow and ripen readily in the open air, and the more delicate kinds of fruit, are likewise produced in profusion.

Turnips, carrots, parsnips, onions, and all root and vegetable crops, are very prolific in New Zealand, and of the finest quality. Thirty-five tons per acre of turnips, is not an uncommon yield: specimens of the white Belgian carrot have been shown at the Horticultural Shows, weighing as much as nine pounds; and cabbages have been grown in Otago weighing from 40 to 50 lbs. each.

The following is a Comparative Table of the average yield of Grain Crops per acre in the various countries named :—

TABLE B.

	WHEAT. Bushels.	OATS. Bushels.	BARLEY. Bushels.
England	30	34	34
Scotland...	26	40	32
Ireland	24	40	26
America (U. S. & Canada)	25	35	30
Victoria	20	23	20
New South Wales	15	20	15
South Australia	11¾	15	16½
New Zealand	32	40	40

The above figures show a great preponderance in favour of this Colony; but it is worth remarking that in New Zealand that impoverishment of the soil by repeated cropping for a series of years, to which the declining yield in Australia is undoubtedly owing to a large extent, has not yet occurred. Our farmers are not altogether free from this injurious practice, but the example set by a few thoroughly practical agriculturists will, it is to be hoped, lead to the adoption of a really scientific system of farming.

The following statistical information, from the *New Zealand Gazette*, 18th May 1865, will be found interesting :—

TABLE C.

NUMBER OF ACRES OF LAND, *in the Possession of Europeans, Fenced and under Crop in December* 1864.

PROVINCES.	Total number of acres fenced.			Total under crop.			IN WHEAT.			IN OATS.			IN BARLEY.			IN MAIZE.			IN POTATOES.			IN SOWN GRASSES.		
	A.	R.	P.	A.	R.	P.	A.	R.	P.	A.	R.	P.	A.	R.	P.	A.	R.	P.	A.	R.	P.	A.	R.	P.
Auckland......	129,148	0	0	87,556	0	0	856	0	0	3,411	0	0	154	0	0	761	0	0	3,477	0	0	75,842	0	0
Taranaki	8,134	0	0	9,769	0	0	58	0	0	211	0	0	5	0	0	0	0	0	293	0	0	9,006	0	0
Wellington ...	127,350	0	0	95,416	0	0	764	0	0	1,720	0	0	116	0	0	15	0	0	665	0	0	90,287	0	0
Hawke's Bay	65,671	0	0	21,880	0	0	229	0	0	663	0	0	63	0	0	22	0	0	222	0	0	19,861	0	0
Nelson ...	91,411	0	0	32,068	0	0	3,221	0	0	2,539	0	0	793	0	0	13	0	0	528	0	0	22,740	0	0
Marlborough	86,033	0	0	8,189	0	0	971	0	0	1,069	0	0	411	0	0	41	0	0	225	0	0	4,428	0	0
Canterbury	342,416	0	0	68,725	0	0	13,328	0	0	14,670	0	0	2,432	0	0	107	0	0	1,753	0	0	31,670	0	0
Otago ...	151,516	0	0	49,158	0	0	5,817	0	0	21,088	0	0	848	0	0	18	0	0	3,069	0	0	15,895	0	0
Southland ...	70,341	0	0	9,549	0	0	352	0	0	5,613	0	0	82	0	0	10	0	0	878	0	0	2149	0	0
Chatham Isl'd	364	0	0	345	0	0	11	0	0	14	0	0	..		..	1	0	0	55	0	0	246	0	0
Totals ...	1,072,384	0	0	382,685	0	0	25,607	0	0	50,998	0	0	4,904	0	0	988	0	0	11,165	0	0	272,124	0	0

From the above table it will be seen that the greatest quantity of fenced land was in the Province of Canterbury; whilst the Province which had the greatest number of acres under crop was Wellington. The table also shows the relative distribution of the various descriptions of crops in the several Provinces. The greatest area of land under Wheat, was in Canterbury; the greatest Oat-growing Province, Otago; whilst Canterbury grows the greatest quantity of Barley. Auckland produces the greatest quantity of Maize and Potatoes, although Otago had scarcely less area of land devoted to the latter crop. The greatest extent of sown grass is in the Province of Wellington.

TABLE D.

SHOWING THE PROGRESS OF CULTIVATION in each Province, during the triennial periods from 1858 *to* 1864.

PROVINCE.	NO. OF ACRES FENCED.			TOTAL UNDER CROP.			WHEAT.			BARLEY AND OATS.		
	1858.	1861.	1864.	1858.	1861.	1864.	1858.	1861.	1864.	1858.	1861.	1864.
Auckland	90,468	112,318	129,149	60,212	75,916	87,556	2,323	3,892	856	2,852	2,554	3,564
Taranaki*	12,706	9,858	8,134	12,156	10,153	9,769	764	61	58	616	163	215
Wellington	40,841	76,611	127,350	26,024	55,813	95,415	1,128	2,285	764	1,574	1,604	1,836
Hawke's Bay	4,143	31,781	65,671	1,331	5,844	21,880	336	550	228	139	391	725
Nelson (including Marlborough in 1858) ...	45,337	37,299	91,411	17,997	22,934	32,068	3,085	4,395	3,221	4,195	2,986	3,332
Marlborough	—	20,455	86,033	—	3,162	8,189	—	493	970		466	1,480
Canterbury	22,926	72,937	342,416	13,935	32,807	68,727	4,239	12,785	13,328	3,254	6,025	17,104
Otago (includ'g Southland in 1858) ...	19,139	42,254	149,699	9,363	19,254	48,373	1,836	4,928	5,734	2,885	4,683	21,655
Southland	—	5,957	70,341	—	1,114	9,549	—	138	352	—	465	5,695
Totals	235,560	409,472	1,070,203	141,018	226,497	381,523	13,711	29,527	25,511	15,515	19,337	55,606

* The disastrous effects of the Native disturbances are markedly evinced in the case of this unfortunate Province, which, whilst every other Province in the Colony exhibits a rapid rate of progress in settlement, shows a decline amounting in the last triennial period to about 25 per cent. on the area of land fenced and under cultivation in 1858.

TABLE E.

GIVING the Total Quantity of Grain, Flour, Bran and Potatoes, EXPORTED from New Zealand during the years 1858 *to* 1864, *both inclusive.*

	1858.		1859.		1860.		1861.		1862.		1863.		1864.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity	Value.	Quantity	Value.	Quantity	Value.	Quantity	Val.
		£		£		£		£		£		£		£
Barley ...	2240 bsh.	687	9148 bsh.	2434	7782 bsh.	2094	...	...	30 bsh.	10	3238 bsh.	1160	...	...
Bran ...	17,974 „	1245	11,228 „	654	14,145 „	876	3586 bsh.	200	...	...	...	...	...	...
Flour ...	68 tons	1261	102 tons	2405	18 tons	378	4¼ tons	89	...	...	...	...	16 cwt.	25
Maize ...	160 bsh.	50	...	...	...	...	...	...	200 „	60	...	...	...	...
Oats ...	47,579 „	18,142	81,405 bsh.	25,059	36,733 bsh.	6865	119 bsh.	25	...	...	...	...	...	...
Wheat ...	21,426 „	6801	28,192 „	11,523	11,168 „	4153	497 „	120	6047 „	1660	...	...	...	...
Grain not described	...	...	...	...	...	...	7502 „	2373	325 „	91	...	...	3580 bsh.	722
Potatoes	6116 tons	33,056	2787 tons	10,758	2124 tons	13,653	953 tons	4121	2533 tons	9527	514¼ tons	3255	5 tons	1085
Totals	...	56,242	...	52,833	...	28,019	...	6928	...	£11,348	...	4415	...	1832

The total value of Grain, Flour and Bran, exported from New Zealand in 1853, £21,269; in 1854, £45,319; in 1855, £88,660; in 1856, £28,152; and in 1857, £32,525.

The value of Potatoes exported from the Colony in 1853, £29,673; in 1854, £61,152; in 1855, £91,509; in 1856, £19,958; in 1857 £23,328.

There were forty-one exhibitors of cereals, chiefly from the Province of Otago. Auckland was represented by only one exhibitor, whilst the other North Island Provinces were entirely unrepresented. Nelson was represented by two exhibitors—Canterbury by three—Otago by seventeen—and Southland by two. The Colony of Tasmania furnished eight exhibitors—South Australia four ; and a sample of prize wheat was exhibited by M. C. de Biseau, d'Hautteville, Belgium ; and there were two exhibitors from Great Britain. It was a source of regret to the Jurors that four of the New Zealand Provinces—viz., Hawke's Bay, Taranaki, Wellington, and Marlborough—had entirely abstained from exhibiting Owing to this circumstance, great difficulty was felt in arriving at a fair estimate of the comparative agricultural capabilities of the various Provinces. It would have been of great value to be able to estimate fully the effects of the various conditions of climate which are to be found in New Zealand. As it is, so much of this report as refers to the agricultural conditions of the Provinces above named is founded upon information, the result of the individual observation of some members of the Jury, and documentary sources. On the other hand, the exhibits from the Middle Island Provinces, although not so numerous in some instances as would have been desirable, may be considered to fairly represent the capability of this part of the Colony for the production of grain. The result of the examination made by the Jury was eminently satisfactory—revealing the fact that a very marked improvement has been established in every description of cereal produce cultivated in New Zealand. The Jury was enabled, by comparing them with samples of the best grain produced in the neighboring Colonies, to arrive at an accurate opinion of the character of the New Zealand samples, and of their relative value. It is to be regretted that the exhibitors did not supply many items of information which would have much added to the exhibition value of the samples shown. It would have been very interesting and instructive to learn the character of the soil, the yield per acre, and other particulars ; and the Jury would suggest that at any future Exhibition full information on these topics should be required from exhibitors. They also feel called upon to remark upon the absence of official agricultural returns, such as in the other Australasian Colonies are annually made to the Government, and published for general information. With the exception of the triennial census, no record of the progress of agriculture in New Zealand exists, and the returns included in the general census are confined to the bare report of the quantity of land under cultivation, and the areas occupied by certain crops. In the

neighboring Colonies the importance and value of detailed statistics of agriculture is recognised, and the official returns of each Colony contain full information by which the condition and progress of each branch of agriculture is plainly demonstrated. In another portion of this report will be found references to statistics affecting the condition of agriculture in the neighboring Colonies; and it will be at once apparent, on consulting them, how valuable similar information with reference to our own Colony would be. It would be no very difficult matter for each Provincial Government to require annual returns from the various districts, so that the progress of agriculture could be fully ascertained in each year. It may not be out of place also to refer in this report to the important influence of Agricultural Societies and periodical Exhibitions of produce. As yet associations of this character have not taken that important stand in this Colony which, to be of permanent value, they should do, and it is very desirable that every encouragement should be given to their establishment and operations. In the absence of any department of the General Government specially devoted to Agriculture, local societies could accomplish many of the purposes of the Board of Agriculture in the Australian Colonies; such as the compilation of statistics, the dissemination of knowledge in agricultural chemistry, the analysis of soils, and other cognate matters, all of which are of great importance in a Colony which aims at the development of its agricultural resources.

Many of the statements referring to the agricultural capacity of New Zealand, as compared with that of other countries, have necessarily been derived from the personal experience and knowledge of members of the Jury, and from careful inquiries in reliable quarters; and the Jury desire to express their thanks to the various gentlemen whose opinions were freely accorded, and whose personal knowledge considerably aided the decisions of the Jurors. The reporter has also been indebted to the courtesy of several gentlemen for many of the statistics, and much of the information conveyed in this Report. He would particularly thank Mr. Young, of Dunedin, whose extensive practical knowledge of the cultivation of grain in Great Britain, Canada, the United States, South America, and in New Zealand, rendered his opinions of much value.

AUCKLAND.

1716.—E. King exhibits a collection of seeds, including Wheat, Maize, Oats, Canary, Sorghum, Linseed, Capsicum, and Sunflower. The wheat does not in the opinion of the Jury, do justice to the Auckland province, it being much inferior, in every respect, to the samples shown from other

parts of the Colony. There are many districts in the Province of Auckland in which wheat should be raised of first-rate quality. No doubt the opening up of the rich lands of the Waikato and Thames districts to European colonisation, will result in greater attention being paid to this branch of agriculture. The sample of Maize is a very creditable one, and an example of the suitability of the Auckland climate for the growth of this cereal.

Reference has already been made to the absence of exhibits from the other North Island provinces. The regret previously expressed at this circumstance will be the better understood by the statement of one of the Jurors—"That the best sample of New Zealand wheat he had ever seen, was some wheat of the Talavera variety, grown by the natives at Manawatu, in the Province of Wellington." The Maoris are extensive wheat growers, and possess many flour-mills of their own. A large quantity of their wheat produce is sold in the European settlements.

NELSON.

308.—Charles Best exhibits a sample (3 bushels) of barley of the Norfolk Chevalier variety, grown at Appleby, Waimea East, in 1863, by the Exhibitor, on brashy soil, gravelly on the top, with deep vegetable soil below. The crop is stated by the exhibitor to have yielded from 45 to 50 bushels to the acre. The land had only just been broken up, the original vegetation being flax and fern. The Jury unhesitatingly pronounced this to be the best sample of Barley in the Exhibition; and they desire to draw the attention of agriculturists in New Zealand to the great superiority of the Chevalier variety, over the other kinds exhibited.

1730.—A. Saunders exhibits an excellent sample of flour.

CANTERBURY.

1733.—D. W. Wood exhibits samples of Wheat, Oats, Peas, Beans, Flour, and Chaff of fair average quality.

1729.—E. Seggall exhibits two samples of Oatmeal, for which an Honorary Certificate was awarded by the Jury.

1718.—W. H. Lane sends a sample of Flour, of moderately good quality.

OTAGO.

This Province is exceedingly well represented. The samples of Wheat exhibit generally a decided improvement, and shew that the Farmers are paying greater attention to the selection of suitable seed. It has been commonly believed that the climate of Otago is rather unfavorable to the growth of wheat, owing to its variableness at the period of harvest. The wheat hitherto grown in this Province has not held a high place in the

estimation of the millers, owing to its softness, and not being sufficiently dried. The superiority of the South Australian wheat consists in its having a thinner skin, being drier, and containing more gluten. These points of excellence are, no doubt, largely due to the favorable conditions under which the wheat is ripened in South Australia, and the circumstance that the wheat is thrashed on the field, and at once conveyed in good order to the warehouse. In Otago, however, sufficient attention has not been paid to securing the crop at favorable times, and the practice is resorted to of piling the corn in slovenly-made stacks, unprotected from moisture at the bottom, and exposed to the rain at the top, careful thatching being seldom resorted to. The result has been, that the stacks become thoroughly penetrated by damp; the corn loses its condition, and when it comes to be ground, yields an inferior kind of flour. The Jury unanimously expressed the opinion that, by a judicious selection of seed—spring varieties being especially wanted—and more careful attention in the matter of harvesting and storing, wheat of equal quality to the Australian could be produced. This opinion is supported by that of several South Australian farmers who have settled in this Province, and who express themselves satisfied that the *climate* has been made answerable for many defects for which it is not responsible.

The principal wheat-growing districts in Otago are the alluvial plains of the Taieri, Tokomairiro, and Clutha, and the country in the neighbourhood of Oamaru and Shag Valley. Some excellent wheat land is found at Moeraki and Waikouaiti. The soil about Oamaru is a loam with a subsoil of limestone; the wheat grown in this neighbourhood is finer and harder than that grown in the interior.

The Oats exhibited fully maintained the superiority hitherto manifested by Otago in this cereal. The samples were full and solid, and in excellent condition.

A great improvement is also to be noticed in the quality of the Barley grown in this Province. Greater attention is being now given to the cultivation of this cereal, the demand for it for malting purposes being very extensive. The Jury would direct attention to the necessity of careful threshing, as being imperative for barley intended for malting. Much of the machine-threshed barley is rendered unfit for malting purposes, owing to the ends of the grain being broken off, and its germinating powers being thus destroyed. Even in England, at the present time, much of the malting barley is still threshed with the flail for the better preservation of the grain.

1701.—D. Andrews, East Taieri, exhibits an excellent sample of Wheat. The same exhibitor shows also a fair sample of Flour.

1706.—Douglas, Alderson, & Co. exhibit a sample of Rye of fair quality.

1708.—Duncan & Young exhibit samples of Otago and Adelaide grown Wheat, Maize, Flour, Meal, Oats, Barley, and Bran. The samples of Flour received the commendation of the Jury.

1710.—J. L. Gillies, Tokomairiro, exhibits a sample of Oats of good quality.

1711.—P. Grant, West Taieri, shows Oats of very fine quality.

1712.—J. Hassell, Oamaru, exhibits excellent samples of Wheat, Oats, Barley, and Flour. The Barley was considered deserving of special mention.

1713.—J. Jones, Waikouaiti, exhibits fair samples of Wheat, Oats, and Flour.

1715.—J. Kirkland, East Taieri, exhibits a very fine sample of Wheat.

1716.—A. King, Kaikorai Mills, shows a first-class sample of Oatmeal, pronounced by the Jury to be the best in the Exhibition.

1714.—A. S. Jones exhibits three samples of Wheat, Oats, and Flour.

1722.—George Matthews shows an extensive collection of Garden Seeds, Grasses, Clovers, Brooms, Gorse, Beets, Gum-tree and Stringy-bark seeds.

1723.—Alexander Miller shows a very fair sample of Barley.

1724.—Peter M'Gill shows excellent samples of Wheat, Oatmeal Flour, and Oats. The oats are deserving of special commendation, and were considered by the Jury as the best samples in the Exhibition. They were grown by Mr. John Elder Brown, of Tokomairiro.

1725.—Richardson & Booth exhibit a very good sample of Malt made from colonial-grown Barley.

1727.—J. Reid shows a sample of Wheat of good average quality.

1731.—W. Strachan exhibits Malt of superior quality, pronounced by the Jury to be the best exhibited.

1732.—A. Todd, East Taieri, shows a very creditable sample of Flour.

SOUTHLAND.

1702.—J. C. Woodford exhibits samples of Wheat, Rye Grass seed, and Oats. The Rye was considered deserving of an Honorary Certificate.

1709.—G. Dawson shows a fine sample of Oats.

TASMANIA.

In the Cereal Class, as in almost every other, the Colony of Tasmania is very well represented; and great praise is due to their local committee for the pains they have evidently taken to secure an adequate representation of the agricultural capabilities of the Colony.

Tasmania is certainly second to none of the Australasian group in the fertility of its soil, and the suitability of its climate to the growth of cereal produce. It is much to be regretted, however, that in this Colony, agriculture has during the past few years shown a serious decline. This unsatisfactory condition of things is difficult to account for. The falling off is not due to any special cause, either of unfavorable seasons, or extensive emigration. On the contrary, Tasmania has been remarkably free from natural obstacles to the progress of agriculture, whilst it has enjoyed a ready market in the neighboring Colonies for its produce; but the official returns reveal a great decrease in the agricultural produce of that island during the year 1864. In the export of flour, as compared with 1863, they show a decrease of 398 tons. But the decrease in the quantity of wheat is beyond all precedent, in a Colony where no actual failure of the crop has occurred. As compared with the export of 1863, there is a decrease of 72,141 bushels; with that of 1862, 156,530 bushels; and with 1861, the extraordinary quantity of 204,015 bushels. In oats, the decrease runs thus:—As compared with 1863, 55,405 bushels; with 1862, 156,930; and with 1861, 315,352 bushels. Potatoes show a decrease of 2,106 tons on the previous year. On the other side there is an increase of 15,167 bushels of green fruit and 14,220 packages of jams.

1704.—C. F. Cresswell exhibits an extensive assortment of samples, comprising Grain, Peas, Hops, Grass and Clover Seeds, and a valuable collection of seeds of the indigenous trees and shrubs of the Colony. The most commendable of the samples were those of Garden Peas, which were considered by the Jury worthy of especial praise. The collection of indigenous seeds also deserves commendation. The Tares were the best shown in the Exhibition, and the same remark applies to the Rye-grass seed.

1705.—R. Doctor shows a fair sample of Oats.

1719.—J. Lipscombe exhibits samples of Peas, Beans, Tares, Grasses, and seeds of indigenous trees. The fine collection of seeds of Tasmanian forest trees was considered worthy the award of an Honorary Certificate.

1720.—A. Morrison shows Wheat of average quality.

1728.— — Ritchie exhibits samples of fine and coarse Oatmeal of good quality.

1734.—Walker & Son exhibit a sample of Malt of good character.

1735.—J. M. Wilson exhibits malt of good quality.

1736.—J. Walton shows an excellent sample of Barley, which was considered to be but slightly inferior to that exhibited by Mr. Best of Nelson. The grain shows all the qualities of a good malting Barley.

SOUTH AUSTRALIA.

This Colony stands at the head of the wheat-growing countries in this hemisphere, not only on account of the large quantity it produces, but of the excellent quality of the grain. The rapid growth and the very favorable conditions of climate at the time of ripening combine to give to the South Australian wheat peculiar excellence. Reference has already been made to the smallness of yield of wheat per acre in this Colony, and further remarks on this subject will be found in the extracts elsewhere, taken from the official reports of the Government Statist. The folly of exhausting the valuable properties of the soil by repeated cropping with the same description of produce is strikingly manifested in South Australia, where the habit has been followed of sowing wheat on the same ground for many years in succession. The natural result of this process has been the gradual deterioration in the fecundity of the soil, and decrease in the yield of grain.

Mr. J. Boothby, the South Australian Government Statist, in his Report for the year 1864–5, makes the following remarks :—

"The total area of purchased land is 2,893,814 acres, or 19·64 acres per head of the estimated population. Two-thirds of the alienated land is returned as being in the occupation of freeholders. Twenty per cent., or one in every five acres of the purchased land is under cultivation, as was the case in 1863. It would appear, therefore, that the sale of land, large as it was (225,171 acres in 1864), did not exceed the requirements of the agriculturist.

"Notwithstanding the large purchases of land for grazing purposes, it is important to note that the ratio of cultivated to untilled land is maintained as one to four; and it will be observed that the per-centage of increase of cultivation during the season under review is similar to the rate at which the land sales were augmented during the twelve months preceding.

"In comparison with the respective populations, there is five times more land under tillage in South Australia than in the adjoining Colonies; there being four acres for every man, woman, and child in the Province, or twelve acres for every male of fourteen years of age and upwards. A considerable increase again appears in the extent of enclosed land, which now amounts to 3,499,098 acres.

"The total area of land under cultivation amounts to 587,775 acres, against 555,968 acres in the previous season—showing 31,807 acres additional, or 5¾ per

cent.; the increased tillage being principally found in the Northern agricultural district, comprised in Counties Gawler, Light, and Stanley.

"The favorable position in which the farmers had been placed by the abundant yield of the harvest of 1863–4, and the high prices ruling throughout the year naturally induced them to use their utmost exertions to place as much land under wheat as possible—the result being, that whilst the increased area of land under tillage is 31,807 acres, as above stated, the additional area under wheat is 55,078 acres—the hay land and fallow being reduced proportionately.

"The acreage of the wheat crop amounted to 390,836 acres, or two-thirds of the whole cultivated land. In 1863–4 there were 337,758 acres under wheat, or 60 per cent. of the tilled land; the increase this season has therefore amounted to 6 per cent. The total produce of the harvest was 4,252,949 bushels, compared with 4,691,919 bushels in the yield of the previous harvest, showing a decrease of 438,970 bushels, the average yield per acre being only 11 bushels as against 14 bushels, and one bushel less than the average production of the past seven seasons.

"On one occasion only during that period has the harvest been less productive, namely in the year 1859–60, when only 9 bushels 38 lbs. per acre were reaped. The yield for each season, and other particulars respecting the cultivation of wheat during the septennial period just closed, is given in the following table. It will be seen that in that short space of time the growth of wheat has nearly doubled:—

SEASON.	ACRES CULTIVATED.	ACRES UNDER WHEAT	PRODUCE WHEAT.	AVERAGE PER ACRE.	
			Bushels.	Bus.	lbs.
1858–59	264,462	188,703	2,109,544	11	11
1859–60	361,884	218,216	2,103,411	9	38
1860–61	428,816	273,672	3,576,593	13	4
1861–62	486,667	310,636	3,410,756	10	59
1862–63	494,511	320,160	3,841,824	12	0
1863–64	555,968	335,758	4,691,919	14	0
1864–65	587,775	390,836	4,252,949	11	0

"There can be no doubt that the low average of the South Australian wheat crop is owing to the imperfect cultivation of a great portion of the land. Many small holders are compelled to plough and sow the same land year after year without intermission or any attempt to replenish the soil by fallowing or other means—resulting in a very low return, and thus reducing the average yield for the whole Colony, which is almost invariably exceeded by the better class of farmers, whose more extensive holdings enable them to pursue a systematic plan of operations, in which more careful tillage, rest for the soil, and a combination with stock-farming are stated to be essential to, and generally productive of, success.

"Seven-eighths of the wheat crop was reaped by machine, the area hand-reaped being less than last year, notwithstanding the increased cultivation. One, if not the most important, advantage our farmers possess over those of the sister Colonies is the expedition and economy with which their crops can be secured, owing to the

successful working of the reaping machines now universally used on all but hilly land, permitting the grain being reaped, winnowed, cleaned, and bagged on the harvest-field, and removed into the store ere the day is closed.

"There were 12,585 acres of barley sown, or 1,395 acres less than the previous season; the quantity reaped being 207,022 bushels, or 46,979 bushels less than last year, the average yield per acre being as low as 16 bushels 22 lbs. The yield of oats was still worse—only 15 bushels to the acre. The quantity grown was 75,135 bushels.

"One-fifth more land was planted with potatoes, but the quantity dug only exceeded that of the previous year by 224 tons; 2,963 acres were sown, yielding 6,493 tons, or 44 cwt. to the acre—being 11 cwt. less than last season's average."

It will be interesting to the agriculturist to be able to see at one glance the average prices of South Australian wheat during the eight years from 1857 to 1864 inclusive. In 1857 the average was a fraction less than 7s.; in 1858, 6s. 8¾d.; in 1859, 9s. 2d.; in 1860, 7s. 7d.; in 1861, 5s. 9d.; in 1862, 4s. 9½d.; in 1863, 4s. 9d.; and in 1864, 8s. 1¼d. The lowest price of wheat during the period was 4s. per bushel, in February and March 1863. The highest was in September 1859, when the price for the month averaged 14s. 9d. per bushel.

The exports of flour and wheat from South Australia from January 1st to December 31st, 1864, were: flour, 41,908 tons; and of wheat, 205,547 quarters. This, at the rate of forty-five bushels of wheat to the ton, is equal to 78,434 tons of flour. In 1863 the total exports were 59,762 tons. Of the total quantity of breadstuffs exported, New South Wales took 13,614 tons of flour, and 60,705 quarters of wheat; and Victoria 11,261 tons of flour, and 81,420 quarters of wheat. Queensland had 3,480 tons of flour; New Zealand 4,514 tons of flour and 19,966 quarters of wheat. These figures show to what a large extent the neighboring Colonies are dependent on South Australia for their breadstuffs.

1707.—Elliot & Kickwick, Adelaide, exhibit samples of Wheat and Flour of excellent quality.

1711A.—E. & W. Hackett exhibit a sample bag of Wheat, which fully maintains the reputation of the Colony for this cereal.

1721.—Magarey & Co., Adelaide, shows a sample of Flour, which was justly regarded by the Jury as superior to any in the Exhibition. It possesses in an eminent degree all those essential qualities for which the flour of this exhibitor is celebrated.

1726.—M. Rankine, Adelaide, exhibits a small sample of excellent Wheat.

1703.—Griffith Cant, Adelaide, shows Wheat of undoubted excellence, it being the best sample in the Exhibition.

GREAT BRITAIN.

2907.—P. L. Simmonds, London, sends a valuable collection of Agricultural and Oil Seeds of Commerce, to many of which the climate and soil of New Zealand are adapted. The collection was presented by the exhibitor to the Commissioners, and by them to the Colonial Museum.

2906.—Alfred Minton, Windsor, exhibits a very fine collection of Agricultural and Garden Seeds, comprising samples of most of the best known varieties.

HONORARY CERTIFICATES.

1703. GRIFFITH CANT, Adelaide.—Superior wheat.
1701. JOHN ANDREWS, East Taieri.—Otago grown wheat.
1715. JOHN KIRKLAND, East Taieri.—Otago grown wheat.
1708. DUNCAN & YOUNG, Dunedin.—Flour from New Zealand wheat, of excellent quality.
1724. PETER M'GILL, Tokomairiro.—Oats of superior quality.
1711. PETER GRANT, West Taieri.—Oats of superior quality.
1716. A. KING, Kaikorai Mills, Dunedin—.Oatmeal.
1712. J. HASSELL, Oamaru.—Barley.
1781. W. STRACHAN, Dunedin.—Colonial malt.
1721. MAGAREY & Co., Adelaide.—Flour of superior quality.
1730. A. SAUNDERS, Nelson.—Flour.
1704. C. F. CRESSWELL, Hobart Town.—Superior quality of garden peas, beans, tares and ryegrass, and valuable collection of seeds indigenous to Tasmania.
1702. J. C. WOODFORD, Southland.—Ryegrass seed.
1733. D. W. WOOD, Canterbury.—Wheat.
1719. J. LIPSCOMBE, Tasmania.—A valuable collection of seeds of plants and trees indigenous to Tasmania.
2906. ALFRED MINTON, Windsor, London.—Excellent collection of garden and other seeds.
308. CHARLES BEST, Nelson.—Very superior barley (Chevalier).
1736. J. WALTON, Tasmania.—Barley.

---

*Juror of Class 3a who is also an Exhibitor.**

1725. T. RICHARDSON (Richardson and Booth).

* If an Exhibitor accepts the office of Juror, no certificate can be awarded in the Class to which he is appointed, either to himself individually or to the firm in which he may be a partner.—*Decisions on points relating to the Exhibition,* 11 *(i.)*

CLASS III.

SUB-CLASS B.—DRYSALTERY, GROCERY, AND PREPARATIONS OF FOOD AS SOLD FOR CONSUMPTION.

JURORS.

JNO. R. SMITH	WM. BARRON.

COFFEE.

THE only samples of colonial-grown coffee were one from Rorotonga, in the South Seas, exhibited by Messrs. Combes & Daldy (17), Auckland; and one shown by Mr. Warner (2703), Brisbane, Queensland. The first mentioned sample was of inferior quality, but interesting as showing the capability of the islands of the South Sea to produce this, amongst other valuable articles of commerce. The sample of Queensland coffee was grown by Mr. James Warner, at Kangaroo Point, Brisbane. The production is from young trees of about four to five years' growth from seed, also grown at the same place, so may be said to be fairly acclimatised. When newly gathered the sample weighed 5¼ ozs. The Jury considered this a very excellent coffee, a fine full berry, and if only better dried, would rank very high as a useful coffee.

There were several exhibitors of prepared coffee, roasted and ground, the quality of which was generally good.

CHICORY.

An interesting series of specimens of colonial-grown chicory, raw and manufactured, was exhibited by Messrs. P. W. Hutton & Co. (1071), Dunedin, a firm that has devoted a good deal of attention to the cultivation of this useful root. The same firm exhibited a full-grown chicory plant in flower in the corridor. The consumption of this substitute for coffee is very considerable in New Zealand, and there is little doubt that the cultivation of the plant could be profitably carried out; one great inducement being the high protective duty on the imported article. The quality of Otago chicory is fully equal to Victorian or English, and when tasted by an expert will be found to possess in a large degree those quali-

ties which have tended so much to make chicory a staple article of commerce. The climate and soil of New Zealand are very suitable for the cultivation of this plant.

The best time for sowing the seed is in December and January, and the crop is ready for collection in about five months; and in rich ground, from 18 to 24 tons per acre may be calculated upon.

2810.—Messrs. Murray & Murdoch, Hobart Town, exhibit samples of prepared Chicory of moderate quality.

CHOCOLATE AND COCOA.

2903.—Messrs. J. S. Fry & Sons, Bristol and London, exhibit a large case containing a series of specimens illustrating the manufacture of Chocolate and Cocoa, viz.:—

I. *Botanical Specimens.*—1. Pod of the Cocoa-tree (*Theobroma Cacao*). 2. Pod cut open, showing the fruit, which forms the Cocoa of commerce. 3. Section of the wood of the Cocoa-tree polished; and other botanical illustrations.

II. *Specimens of Raw Cocoa* as imported from Caraccas, Guayaquil, Bahia, Trinidad, Grenada, and Surinam.

III. *Illustrations of the Stages of Manufacture.*—1. Roasted Cocoa (Trinidad). 2. Husk or "shell," chiefly used in Ireland. 3. Cocoa nibs: the kernel of the nut bruised and separated from the husk. In this form cocoa is extensively used; and, when boiled, these nibs produce a clear and fine-flavored cocoa. 4. The oil of the Cocoa-nut (or cocoa butter). 5. Chocolate, in moulds, &c.

IV. *Chocolate and Cocoa.*—1. Chocolate confectionery. 2. Chocolate in cakes. 3. Homœopathic Cocoa. 4. Iceland Moss Cocoa.

Cocoa is a rich and nutritious food, containing in 100 parts, 51 of butter, 22 of starch and gum, 20 of gluten or flesh-forming matter, and about two parts of a principle called *Theobromine*, to which no doubt its peculiar character is due. *Theobromine* contains more nitrogen than *Theine*, the active principle of tea and coffee.

The high position which Messrs. Fry & Sons have taken at the Great Exhibitions in London, Paris, and New York, makes it unnecessary that the Jury should say further than that the reputation of the firm is fully sustained by their exhibits.

SUGAR.

The Colony of Queensland appears likely to become the purveyor to the Australasian colonies of most varieties of tropical produce. Two samples of sugar from the Ribbon cane are exhibited by the Hon. Louis Hope

(2704), Cleveland, grown and manufactured by him. The sugar is very good in quality. The yield of this sugar was three tons per acre, and the market price 5d. per lb. The sugar cane was first cultivated in Queensland by a planter from the Mauritius named Adam, who formed small plantations near Grafton, Clarence River, in lat. 29½° S., 2° South of Brisbane. As much as four tons to the acre has been yielded.

DRIED FRUITS.

Samples of dried Raisins, grown and dried in Napier, are exhibited by the Misses Wilson (115). A moderately good sample of Currants is shown by Mr. Joseph Gilbert (2431), Pewsey Vale Vineyard, South Australia.

PRESERVED FRUITS AND JAMS.

There were several exhibitors of preserved Fruits and Jams, the manufacture of which was on the whole very creditable. In preserving fruits for jam, it is necessary to retain the individual flavor of the fruit, a desideratum which is too often neglected. The use of common sugar, and too high boiling, will inevitably destroy the fruity flavor of the preserve.

Andrew M'Ewen (18), Matakana, Auckland, and George Webster (19), Hokianga, exhibit assorted Jams of very good quality. The Cape Gooseberry and Peach Jam of the latter exhibitor deserve special notice. The Jams and Jellies shown by Mrs. S. H. Burningham had undergone fermentation.

John Grey (1070), Dunedin, exhibited bottled Gooseberries and Red Currant Jam of great excellence.

F. C. Davis (2430), Adelaide, shows samples of Dessert Fruits in syrup, of very superior quality.

Walter Hill (2702), Brisbane, exhibits Jams and Preserves made of Citron, Bitter Orange, Loquat, and Lime.

Tasmania is celebrated for its production of jam, a large quantity of which is exported to the Australian Colonies and New Zealand. The use of inferior sugar is a prevailing fault in the manufacture of Tasmanian jams, the consequence being that the flavor of the various fruits is sacrificed. The Jams shown by C. F. Cresswell (2809), were of fair medium quality, but inferior in flavor to the New Zealand jams.

ARROWROOT.

Samples of Arrowroot are exhibited by Messrs. Combes & Daldy (17), Auckland; and by Walter Hill (2702), Brisbane. The first named sample was produced at Rorotonga, and is of tolerably good quality. The

samples from Brisbane are of two varieties, viz.: White Arrowroot, from the *Maranta arundinacea*, a native of tropical America and the West Indian islands; and Purple Arrowroot, from the *Canna edulis*, which is a native of Peru. The sample of the latter description is of excellent quality; in fact both sorts are good. The price is stated to be 7d. per lb. From three to four tons per acre have been produced in Queensland.

CONDIMENTS.

An excellent sample of Cayenne Pepper, grown and manufactured at Matakana, near Auckland, is shown by Mr. Alex. M'Ewen (18). Cayenne Pepper is the produce of the fruit of various species of Capsicum, more especially *C. annuum* and *C. frutescens*, herbaceous plants belonging to the natural order *Solanaceæ*.

BUTTER AND CHEESE.

The only exhibit of Butter was a keg by Mr. J. Sellar (202), Wellington. The Butter is very rich in quality, well cured, and deserves special notice.

Excellent Cheeses were shown by Thomas Powdrell (113), Tutae Kuri, Hawke's Bay. Those by Samuel Mackay (112), and Samuel Begg (108*a*), of the same Province, were also of good quality.

The cheese exhibited by Mr. T. Gifford (311), Nelson, attracted deserved notice, being a first-class rich cheese.

HAMS AND BACON.

The Colonial hams and bacon were, on the whole, of very good quality, and well cured.

Wm. Peakman, Wairoa, Hawke's Bay, (109) exhibits through Mr. Samuel Begg, hams and bacon of excellent quality.

Ure and Co., (2602) exhibit hams and bacon of Victorian cure.

PRESERVED MEATS.

Samples of preserved fish, in tins, were exhibited by Messrs. Marshall and Co. (2407), of Sydney, which, although sound and wholesome, possessed little distinctive flavour.

2701.—Messrs. E. J. Blaxland and Co., Toowomba, Queensland, exhibit tins of dried meat, which the Jury, after careful examination and testing, consider to be a most excellent preparation, and very useful as an article of commerce. It is not unlike the Pemmican, or dried meat prepared by the Indians and hunters in America: like it, it can be exposed to the action of the air for a long period without deterioration, and can be eaten either in its dried condition or cooked. In its ordinary state about ¼-lb. per diem will suffice to sustain a full grown man, and by steeping it

in water and afterwards boiling or stewing it, a very savoury and wholesome dish can be produced. It is cured entirely without salt, and will keep in any climate three years. It should become an article of consumption where unsalted substitutes for fresh meat are desired. The exhibitors state the price to be—beef, 6d., and mutton, 8d. per lb.

2905.—J. T. Morton, London and Aberdeen, sends a variety of Preserved Meats and Fish of excellent quality.

BISCUITS AND CONFECTIONERY.

531.—W. McLennan, Dunedin, sends samples of Biscuits manufactured from Otago flour, which are of excellent quality.

534.—Thos. Taylor, Port Chalmers, exhibits an excellent assortment of Biscuits of good quality.

2603.—Ure and Co., Dunedin, exhibit an extensive assortment of Biscuits, manufactured by Messrs. Smith and Son, Melbourne.

532.—J. A. McDonald, Dunedin, shows a very good assortment of Confectionery, of great variety and general excellence.

1070.—John Grey, Dunedin, exhibits Bride Cake, Confectionery, Jellies, &c., of undoubted excellence.

W. H. HARRISON,
Reporter.

HONORARY CERTIFICATES.

18. A. M'EWEN, Matakana, Auckland.—Cayenne Pepper of excellent quality.
19. GEO. WEBSTER, Hokianga.—Excellence of his Jams.
113. THOS. POWDRELL, Hawke's Bay.—Cheeses.
202a. J. SELLAR, Wellington.—Butter of superior quality.
311. T. GIFFORD, Nelson.—Cheese of superior excellence.
410. TRENT & KNAPMAN, Canterbury.—Prepared Coffee.
531. W. M'LENNAN, Dunedin.—Biscuits made from Provincial Flour.
532. J. A. M'DONALD, Dunedin.—Confectionery.
534. THOS. TAYLOR, Port Chalmers.—Biscuits.
1070. JOHN GREY, Dunedin.—Confectionery of superior quality.
1071. P. W. HUTTON & Co., Dunedin.—Excellent Colonial Chicory.
1072. W. GREGG & Co., Dunedin.—Superior Spices, prepared Coffee and Chicory.
2701. E. J. BLAXLAND & Co., Queensland.—Very superior preparations of Dried Meat.
2702. WALTER HILL, Brisbane.—Purple Arrowroot of superior quality.
2703. JAMES WARNER, Brisbane.—Excellence of Raw Coffee.
2430. F. C. DAVIS, Adelaide.—Excellent Dessert Fruits in syrup.
2429. MRS. L. A. CHANCE, Adelaide.—Excellent Sauces and Pickles.
2903. J. S. FRY & SONS, Bristol.—Excellent preparations of Cocoa and Chocolate.
2905. J. T. MORTON, London.—Preserved Provisions of superior quality.

CLASS III.

Sub-Class C.—WINES, SPIRITS, BEERS AND OTHER DRINKS, AND TOBACCO.

JURORS.

R. H. FORMAN. | J. A. DOUGLAS.

ALE AND PORTER.

THE climate of New Zealand is eminently adapted for the successful brewing of Ale and Porter, and, in this respect, the brewers of this Colony have a great advantage over those in Australia, where the temperature is so high, and subject to such great variation in the course of twenty-four hours, as to make brewing at almost all times a risky operation. In New Zealand, every condition that is considered necessary for the production of first-class ales may be found; a plentiful supply of excellent water, and a moderate temperature, equally suited for malting as for the operations of brewing. The soil and climate are also well adapted to the growth of barley and hops, although the cultivation of these is not so extensive as it ought to be. It is not difficult to account for the comparatively small area of ground devoted to the growth of barley in the Southern provinces; in the first place, it is only within the last two or three years that the increase in the brewing trade has created a steady demand for malting barley; and, in the second, it paid the farmers better to grow oats and wheat. Now, however, that the demand for barley is both considerable and increasing, greater attention is being directed by agriculturists to its cultivation, and a larger area has been devoted to this cereal. The Colonial brewers have been and still are chiefly dependent on imported supplies of malt and barley. In 1862 were imported 26,662 bushels of barley; for 1863, 35,364 bushels.* Of imported malt no returns are given in the Customs reports.

* Returns for 1864 not yet published.—Ed.

Hops of excellent quality are grown in the Province of Nelson, where their cultivation has been attended with the most satisfactory results. It is very much to be regretted that no sample of the Nelson hops was forwarded to the Exhibition, and equally that no ale from Nelson was submitted for competition.

With the possession of such eminent advantages for the manufacture of ale and porter, the brewing trade of New Zealand will no doubt become one of the most important branches of Colonial industry. This hope is much strengthened by the result of the inspection of the various samples submitted to the Jury, and it can scarcely be doubted that New Zealand will become the great brewing, as Australia will become the great wine-growing country, for the supply of the Southern markets.

The Jury called in the aid of several gentlemen as Associates, and of other persons accustomed to the sale and purchase of ales, and they have the satisfaction of being able to state that in every instance in which an award was made it was granted on the unanimous opinion of all who assisted in the examination. The exhibits were tested at various times, and it affords the Jurors the greatest satisfaction to be able to speak in the highest terms of them. As a whole, they are of very good quality, and bear evidence of careful attention in the brewing. The Jurors cannot but express the opinion, that whilst such excellent ale can be produced in the Colony, its consumption should be largely encouraged, as some of the ale exhibited is not only fully equal to much of the imported ale, but much more pleasant than the lower qualities of English beer. Judging from the ales exhibited, the Jury are inclined to think the climate of the Southern Provinces more favourable for brewing than that of the Northern, although this opinion is necessarily only a cursory one, for the reason that some of the largest Auckland brewers did not exhibit at all, whilst the only exhibitor from that Province showed none in bulk.

For ale in bulk, the Jury must unhesitatingly accord the place of honor to Messrs. Marshall and Copeland, Dunedin, whose various qualities of ale scarcely admit of improvement. Whilst thus according the highest praise to the samples exhibited, the Jury think it well to state that they would have wished quotations of the prices of the various qualities. The omission of this information necessarily deprives the opinion of the Jurors of the practical and commercial importance it would otherwise have possessed. This remark applies equally to all the exhibitors in this Class.

The ale exhibited by Mr. M. J. Wilson, Hobart Town, is scarcely inferior

to that of the first-named exhibitors. It is a most agreeable ale, and in sound condition. Tasmania is favourable for brewing operations, and both hops and barley grow there luxuriantly.

Messrs. Ward and Co., Christchurch, likewise exhibit a most excellent ale, which elicited the unanimous commendation of the Jury.

The Porter exhibited by Colonial brewers is not of so good a character as the ale, the production of this beverage being evidently not quite so well understood. Still, the quality is fair, and the liquor by no means disagreeable. The Porter in bulk, exhibited by Messrs. J. L. & C. Burke, Dunedin, and that of Messrs. Marshall and Copeland, were the best submitted to the judgment of the Jury. Both are good articles, suitable for quick draught.

The Bottled Ales and Porter brewed in the Colony, are of a very high character for Colonial productions, more especially the ales.

Messrs. Whitson and Co., Auckland, exhibit four qualities of Bottled Ale, some of which were out of condition. Their India Pale Ale was approved of by the Jury as a good, pleasant ale.

The best samples of Bottled Ale were, undoubtedly, those of Mr. Wm. Strachan and Messrs. Marshall and Copeland. The Ale of the former exhibitor is a really splendid sample—excellent in condition, and of a beautiful colour. Messrs. Marshall and Copeland's Bottled Ale is likewise a first-class article.

Messrs. Richardson and Booth exhibit bottled Ale and Porter o commendable quality; their bottled Porter deserving very favorable mention.

Some idea of the consumption of Colonial-brewed ale is afforded by the quantity of hops imported. In 1863, we imported hops to the value of £16,684, which at the average price of two shillings per lb., would give 166,840 lbs. Assuming the average quantity of hops used by the brewer to be 1 lb. to eight gallons, it would give 1,334,720 gallons, as the annual production of Colonial ale.

Basing the calculation on the same estimate, the annual production of Ale and Beer in New Zealand, during the four years ending December 31, 1863, would be as follows:—

1860	200,720	gallons.
1861	579,920	"
1862	872,640	"
1863	1,334,720	"*

*Returns for 1864 not yet published.—ED.

CONSUMPTION OF IMPORTED WINE, ALE, AND SPIRITS
In the various Provinces of New Zealand in 1863.*

	Ale & Beer.	Spirits.	Wine.
	GALS.	GALS.	GALS.
Auckland	137,914	165,017	46,581
Taranaki	10,954	4,290	1,823
Wellington	94,345	50,115	20,720
Hawke's Bay	9,400	3,567	1,888
Nelson	34,412	19,556	11,268
Marlborough	1,282	2,010	292
Canterbury	226,573	82,499	39,068
Otago	528,812	399,461	103,634
Southland	73,517	99,103	28,045
TOTALS	1,117,209	825,618	253,319

WINES AND SPIRITS.

The exhibitors in this sub-section were—

2909. { William Fred. Cosens, London—Sherry Wines.
{ Silva & Cosens, London—Port Wines.

The Sherry wines included some very fine vintages, and the character of the samples generally elicited the commendation of the Jury. The Port wines are of fair medium quality.

2908.—Jno. Dawson Kiddel, London, exhibits samples of Brandy, Wines, and Vinegar. The brandy and wines are of the ordinary character chiefly consumed.

3901.—The Beaujolais Wine Company, France, are represented by samples of two varieties of red wine—pleasant descriptions of Claret.

The most noticeable feature of this Class, was the Australian wine, of which numerous samples from the various colonies were exhibited. The local repute of these wines, and the rapid progress of wine growing in Australia, invested the examination of the samples submitted to the Jury with considerable interest.

The vine has been cultivated in South Australia for more than twenty years. In 1840, the late George Stevenson, Esq., introduced into that Colony from New South Wales, the collection of vines known as Busby's,

* Detailed Returns are not yet published, but the gross Returns state that duty was paid in 4 on Beer, 983,792 gals.; Spirits 580,311 gals.; Wine 207,843 gals., showing a considerable decrease on 1863. Of Beer, 133,417 gals.; Spirits, 245,307 gals., and Wine, 45,476 gallons.—ED.

consisting of several hundred varieties, some of which were considered eminently adapted to the soil and climate. In the following season many of the sorts included in this collection, were planted by Mr. A. H. Davis, of Moore Farm, on the plains around Adelaide; and also by Mr. G. A. Ansty, on the hills. From these plantations, and from a collection of cuttings obtained from the Cape of Good Hope, the first vineyards of South Australia were constituted. But it was found that the sorts were not the best suited to the climatic conditions and soil, and the experience of the earlier vine growers suggested the introduction of more suitable kinds, or the grafting of good vines on the original stock.

This was accordingly done, but it was not until the year, 1850, that the manufacture of wine was attempted on any important scale. As in many other industrial pursuits, the first results were not satisfactory. The wine, being made from such a great variety of grapes, possessed no distinct quality, and however wholesome as a beverage, was not market,—able. Prior to this, Dr. Kelly, of Morphett Hall, had turned his attention to the cultivation of vines suitable for wine making, and it is mainly to the intelligent perseverance of this gentleman that the colonists of South Australia are indebted for the introduction and successful acclimatisation of the best class of vines. The descriptions to which this pioneer of the vine growers of the colony, directed his efforts, were the kind known as Rousillon vines, comprising Black Portugal, Cavignan, Grenache, Carbonet of Sevena, Malbec, and Mataro. These, with Scyras, Tinta, and Dulcetto, are the kinds most suitable for Port wines. The best known varieties for white wines are, Pedro Ximenes, Tokay, Reisling, Verdeilho, Belas Blanco, Gouais, Muscat of Alexandria, and Frontignac. Dr. Kelly generously distributed cuttings of his best vines amongst the other vine-growers, and in addition wrote a work on the cultivation of the vine and wine making. He was the first to produce wine in any important quantity, and the foremost in the promotion of what bids fair to become one of the most important branches of colonial industry—the manufacture of wine.

The vine flourishes luxuriantly on the plains around Adelaide, as well as on the hills. The best wines are procured from the vines grown on the hills, the moisture prevailing in these localities causing the fruit to arrive at a greater state of maturity, and preventing that extreme rapidity of fermentation which occurs in wines made on the plains. The vine flourishes on a variety of soils. That most suited to it is of a loamy nature, with a strong chocolate clay for subsoil. Hundreds of acres of land of

this description are annually planted, the ground being prepared by subsoiling with the plough to a depth of about eighteen inches. It is then planted with cuttings, set at distances of four feet, in rows six feet apart. These plants yield a few bunches of grapes in the second year after planting, but do not arrive at proper bearing condition until the fourth or fifth year. At this period the crop is as good as ever it is likely to be, the average yield of fruit being from five to seven pounds weight on the dryest soils, and from seven to ten pounds weight on the hills. From rich alluvial flats the produce is much greater.

The vine is a great penetrator for moisture, the roots frequently descending ten or twelve feet in search of water, and when thus supplied will produce an almost unlimited quantity of fruit. But the wine produced from grapes grown under such circumstances, is of inferior quality, and unless sugar is added is comparatively of little value. Distillation being almost prohibited, on account of the vexatious restrictions imposed by the Government, the South Australian Wines are mostly *pure et simple*, and to persons accustomed to "fortified," or brandied wines manufactured to suit the taste, they are unpalatable. Of course age greatly improves them, and no doubt as they become more generally known, they will be better appreciated. As a rule, the Australian Wines cannot be said to equal the productions of the European vineyards, although occasionally varieties are met with which rival the best Wines of Germany. There is a want of the distinctive character which obtains in European Wines, and often the fermentation is defective. It is doubtful if the Australian Wines will become popular in New Zealand, at least not unless the tariff be reduced, so as to bring them in at a cheap rate. The present duty is almost prohibitory of their consumption.

Wine growing is but of recent date in Victoria, but great progress is being made, and the wines are quite equal in quality to those of New South Wales or South Australia. The samples exhibited by Mr. J. Tolmie, of Dunedin, particularly a bottle of Reisling, 1863, were very commendable.

The vintage of South Australia for the present season is estimated at about eighteen thousand hogsheads, a great deal of which is exported to Melbourne and India; and the trade to England is fast increasing, owing to the relaxation of the restrictions on the sale of wine in other than hotels or public houses.

Mr. J. Boothby, the Government Statist of South Australia, in his Report for the year, 1864-65, makes the following remarks concerning the vineyards of that Colony:—

"One tenth more land has been planted with vines, making the total area of our vineyards to be 6,364 acres. Nine years ago they covered only 753 acres. During the past five years the area has doubled. Up to last season the proportion of bearing vines to those not yet productive, was nearly equal; the present returns show 4,596,009 vines in bearing, to 2,831,971 unproductive.

"Only a short period has to elapse before the whole of the extensive vineyards, planted during the past few years, will be in full bearing, so that the annual production of wine will be rapidly augmented. Already the figures are high, for the vintage of the present season cannot be estimated at less than 1,000,000 gallons. That of last year, for which the returns are given, yielded 798,647 gallons, or 192,282 gallons more than its predecessor. It is important to notice, that the quantity of wine now made is more than double that produced three years ago. The home consumption is, doubtless, large, but it would be satisfactory to find a demand in a foreign market, which to the present has not been the case. The exports of the year amounting to 20,674 gallons only, or less by 7,031 gallons than the exportation in 1863."

The cultivation of the vine in Victoria extended from 2,007 acres in 1863, to 3,076 acres in 1864; the number of vines planted from 4,500,000, to 7,000,000, and the wine manufactured, from 92,000 gallons to 121,C00 gallons. At the same time a slight decrease took place in the quantity of grapes sold, and the brandy made, dwindled from 28 gallons to 10 gallons.

The vine grows freely in some parts of New Zealand, but it is doubtful whether any portion of the Colony is sufficiently warm for it in the autumn. For fruit only the vine can be cultivated successfully in the Northern part of the North Island and in favored spots in the Middle Island. Two enterprising vignerons have planted a small vineyard in the warm valley of the Dunstan, Otago, and it is hoped by them that this particular district will prove well suited for the cultivation of the grape. In their examination of the Colonial Wines submitted to their judgment, the Jurors invited the assistance of several other gentlemen, and the decisions arrived at were almost unanimously supported by them. In White Wines they desire to make special mention of the Reisling, 1852, exhibited by Mr. Joshua Gilbert, of Pewsey Vale Vineyard, South Australia. It was the unanimous opinion of the Jury that this was the best wine exhibited. The whole of the wines sent by Mr. Gilbert are of good character, with the exception of the Reisling, 1861, which was very much out of condi-

tion. The Frontignac Wine from Pewsey Vale Vineyard was also favorably thought of. The manner in which the wines of this exhibitor are got up for sale is very commendable. The White Wines exhibited by Messrs. Wyndham Bros., of Sydney, are of good quality, the "Dalwood White," 1862, catalogued at 32s. per doz., being considered a very agreeable wine. The Bukkulla, 1862, from the same vineyard, and priced at 60s. per doz., possessed an unpleasant bouquet, which much detracted from the character of the wine.

H. D. Lindeman, M. D., Cawarra, N. S. W., exhibited samples of Hock, of the vintages, 1858 and 1862, the wines in each case being of a firm marked character.

The Red Wines were not generally of so good a character as the white—and the want of any marked characteristic was specially noticeable. Some of the wines were fair imitations of Claret; others, of a mixed character, and some were unpalatable and out of condition. Mr. Joshua Gilbert, of Pewsey Vale Vineyard, South Australia, exhibited a pleasant Red Wine, "Carbenet, 1858," and his "Scyras, 1854," was also a commendable wine.

A red "Torrentia," exhibited by R. Dawson, Adelaide, calls for favorable notice.

Wyndham, Bros., Sydney, exhibited samples of red wine, of good quality, "Dalwood, 1862," and "Bukkulla, 1862," which gives promise of considerable improvement with age.

The Brandies exhibited by Mr. John Gilbert, of Pewsey Vale, are very commendable.

HOME-MADE WINES, CORDIALS AND AERATED WATERS.

The exhibits of Home-made Wines, were as follows:—

118.—Unintoxicating wine, made from the juice of the wild bramble growing in Hawke's Bay. Produced and exhibited by Mrs. Thompson.

310.—G. W. Lightband, Nelson, samples of Grape, Cherry, Raspberry and Gooseberry Wine, commendable for their pleasant character and cheapness. The prices quoted are from 20s. to 24s. per doz.

312.—T. W. Tatton, Nelson, sent samples of Orange, Ginger, Pepsine, and Quinine Wines. The latter medicinal preparations are useful tonics.

Several varieties of Liqueurs and Cordials, of good quality, were also shown by Mr. Tatton.

520.—Reeves & Co., Dunedin, exhibited Cordials and Syrups of excellent quality.

533.—J. Sutton, Dunedin, sent a preparation of Quinine.

2811.—C. F. Cresswell, Hobart Town, exhibited excellent Raspberry Vinegar.

2812.—Murray and Murdoch, Hobart Town, sent samples of Grape, Cherry and Gooseberry Wines of commendable quality.

The exhibitors of Aerated Waters were as follows—the quality of their productions being generally good :—

202.—Edward Dixon, Wellington, Soda Water and Lemonade.

412.—Thomas Raine, Christchurch, Soda Water.

520.—Reeves & Co., Dunedin, Soda Water, Lemonade.

521.—W. F. Strike, & Co., Dunedin, Ginger Beer, Soda Water and Lemonade.

CIDER.

309.—Samples of bottled Cider, manufactured in Nelson, were exhibited by Mr. Charles Elliott. The cider is of very good quality.

TOBACCO AND CIGARS.

The growth and manufacture of Tobacco has always been a subject of interest to New Zealand colonists, and at the present time the tobacco plant has been successfully acclimatised in various portions of the Colony, and is grown profitably, both by Europeans and Natives. There is little doubt of the favorable nature of the soil and climate for the growth of this plant. In the North Island especially, tobacco will flourish well in suitable localities, and of late years considerable patches have been planted. The Natives have always shewn an intense desire to grow their own supply of tobacco, and now they cultivate it very successfully, and exhibit a remarkable degree of skill in its preparation for use. In the Middle Island, the cultivation of tobacco, has until quite recently been confined to the gardens of the sheep farmers, who occasionally grow an inferior kind, for sheep washing purposes. More attention has latterly been directed to the regular cultivation of this narcotic, which can doubtless in favored situations be profitably grown.

Mr. J. Simpson, of Dunedin, has for several years been engaged in the local manufacture of Tobacco and Cigars. He has used exertions to promote the cultivation of the plant, and to a certain degree has been successful, and it has been satisfactorily demonstrated that a very fair quality of tobacco can be grown in Otago. Hitherto the drying of the leaf has been the chief difficulty, and it cannot be said to have been overcome. Although it can hardly be anticipated that the cultivation of tobacco in New Zealand will ever supersede the necessity of importation,

there does not appear to be any reason why the tobacco used for sheep wash cannot be produced within the Colony.

The exhibits of Tobacco were as follows:—

Auckland.

20.—Andrew M'Ewen, Matakana.—Snuff of pleasant flavor, pungent, but rather coarse.

22.—B. Wooton, Cigars, presumed to be manufactured from local grown tobacco.

Hawke's Bay.

The cultivation of Tobacco appears to have received considerable attention in this Province, and the various samples reflect great credit on their producers. The tobacco, if not equal to the better kinds of American, is very much superior to a great deal that is imported into this Colony. It is to be regretted that no statement of the quantity produced and the cost of production was afforded, as such information would have been very valuable and instructive.

The best sample was exhibited by Samuel Begg, (116) grown at the Wairoa. The roll of Tobacco (119) prepared and grown by the Natives at Tamaki Bush, Manawatu, and exhibited by Mr. John Wilkinson, is of excellent quality, and deserves praise for the soundness of its condition.

The Native grown Tobacco (117) exhibited by the Superintendent of Hawke's Bay, similarly deserves commendation.

Otago.

1073.—John Simpson, Dunedin, exhibits various samples of manufactured Tobacco, Cigars, and Snuff, made from imported and local grown leaf. The Jury desire to commend the efforts made by this Exhibitor to establish an important branch of local industry, efforts which may be considered successful, seeing that a regular demand for his manufactures exists.

New South Wales.

2406.—Phillips & Co., Sydney, exhibit Cigars manufactured from imported Tobacco. The Cigars are well made and of fair quality, and may be considered a very creditable article. The Jury desires, however, to reprehend the practice of imitating the marks and packages of foreign makers.

HONORARY CERTIFICATES.

21. R. WHITSON & Co., Auckland.—For bottled Pale Ale of good quality.
20. A. McEWEN, Matakana.—Snuff made from Colonial Tobacco.
413. WARD & Co., Christchurch.—Ale in bulk of superior quality.
520. REEVES & Co., Dunedin.—Superior Soda Water and Lemonade.
522. J. L. & C. BURKE, Dunedin.—Porter of excellent quality.
525. MARSHALL & COPELAND, Dunedin.—Very superior Ales.
528. RICHARDSON & BOOTH, Dunedin.—Bottled Porter.
529. W. STRACHAN, Dunedin.—Very Superior Ale in bottle.
2601. W. A. TOLMIE, Dunedin.—Victorian Wines.
116. S. BEGG, Hawkes Bay.—Good Colonial grown Tobacco.
117. D. M'LEAN, (Superintendent,) Hawke's Bay.—Tobacco of good quality grown by Natives.
119. JOHN WILKINSON, Hawke's Bay.—Roll Tobacco, grown and prepared by Natives.
2404. WYNDHAM, BROS., Sydney.—White Wine, "Dalwood," 1862.
2404a. H. J. LINDEMAN, Cawarra, N. S. W.—"Cawarra" Wines.
2406. PHILLIPS & Co., Sydney.—Cigars.
2816. M. J. WILSON, Hobart Town.—Very Superior Bitter Ale, in bulk.
2428. JOSH. GILBERT, Adelaide.—"Reisling" Wine, 1852.
2426. R. DAWSON, Adelaide.—"Torrentia" Red Wine.
2909. W. F. COSENS, London.—Sherry Wines of superior character.

CLASS IV.

SUB-CLASS A.—OILS, FATS AND WAX, AND THEIR PRODUCTS

JURORS.

JOHN R. SMITH. | WM. BARRON.

OILS

THE exhibits of Colonial Oils are extremely limited, the cultivation of oil-yielding seeds not having as yet engaged the attention of the Australasian Colonists. There are many varieties of oil seeds for the growth of which the climate and soil of New Zealand and Australia are well adapted, and the consumption of oil is sufficient to induce the effort to supply the demand from home sources. Linseed Oil in particular is an article the consumption of which in the Colonies is extensive for house-painting purposes, and the margin of profit between the cost of production, and the price paid for the imported article, is wide enough to encourage its manufacture.

The production of Olive Oil promises to become an important occupation in Australia. Samples of pure Olive Oil, are exhibited by Messrs. F. H. Faulding & Co., of Adelaide, made from olives grown in the neighbourhood of that city, and manufactured by Messrs. Sinnett and Co.

Olive oil is the most useful and valuable of the vegetable oils, and is used extensively in the arts and manufactures. In Greece, Italy, Spain, and France, olive oil is largely used as an article of food and in cookery. In England it is employed extensively in the woollen manufacture, and for lubricating purposes. The olive is a tree which grows luxuriantly in Italy, from whence the principal supply of oil is received. Some of the Greek Islands export olive oil largely, and the olive flourishes also on the African coast, and in the South of France and Spain. Olive trees begin

to bear at two years old, but are not in full bearing until after five or six years, when they become a source of wealth to their owners. They are of extreme longevity, and will bear luxuriantly when the trunk is quite hollow. The gathering of the olives is performed in different ways. Some cultivators allow the fruit to obtain complete ripeness, and to drop from the trees. Others consider that the fully ripe fruit produces too fat an oil, and one which is liable to become rancid; they therefore gather it a little before it is ready to drop. If the fruit be gathered before it is ripe, the oil is apt to taste bitter. In order to obtain the finest description of oil, the ripe fruit is conveyed at once to the mill, where the crushing is effected in the simplest manner. The oil known as "Salad Oil," so much used for culinary purposes, is that which first exudes from the olives; that which is afterwards extracted not being so fine or pure. It is run off into reservoirs to clarify, and afterwards into casks or bottles.

Oil of olives varies in color from greenish to pale yellow. A little above the freezing point of water, it begins to deposit some white granules of stearine. At 22°, it deposits 28 per cent. of its weight of stearine.

The oil exhibited by Messrs. Faulding and Co., is a beautiful pure looking oil, but has a slightly unpleasant odour. The manufacturers put it up in bottles a third larger than the imported half-pint salad oils, and in price their oil is about the same as the ordinary imported kinds. The consumption of olive oil in the Australian Colonies is considerable, and these samples show that the colonists may, in time, supply their own demand.

The only New Zealand exhibits of oil, are two samples of whale oil, shown by Mr. Samuel Locke, of Napier, Hawke's Bay, from the whaling station at the Wairoa. The whale fishery of New Zealand formerly employed a great number of persons, and a large amount of capital was embarked in the pursuit. Whaling stations were established at various parts of the coast, from the Bay of Islands at the north of the Northern Island, to Jacob's River and Dusky Bay, at the south of the Middle Island. The principal whaling depôt at the present time is at Russell in the Bay of Islands, but only as a rendezvous for whaling ships, which are almost entirely American vessels. A few small whaling establishments survive along the coast, but the pursuit is now of little importance, and whales are much scarcer than formerly. There are very few whaling ships owned in New Zealand; only some two or three, but the neighbouring colony of Tasmania owns a considerable fleet of vessels engaged in the sperm whale fishery. The following table shows the quantity and

value of Oil, chiefly whale oil, exported from New Zealand, from 1853 to 1864 inclusive:—

	TUNS.	GALLS.	VALUE.
1853	404	202	£22,275
1854	189	12	11,055
1855	138	35	8,748
1856	186	251	10,515
1857	243	36	11,943
1858	191	240	8,219
1859	284	15	11,912
1860	84	43	4,275
1861	107	240	5,126
1862	165	131	9,055
1863	—	37,868	8,387
1864	—	17,963	2,945

WAX.

Two samples of Bees' Wax are exhibited by the Waikouaiti District Committee, the produce of bees in the locality.

AMBERGRIS.

Specimens of Ambergris are exhibited in the Hawke's Bay Collection, by Mr. Samuel Locke, Provincial Surveyor of Hawke's Bay, and by Mr. Colenso, in his Cabinet of exhibits. Both specimens were taken from whales caught off the coast. Ambergris is a concretion from the intestines of the spermaceti whale, and is a product of disease, as it is not found in the healthy animal. It is sometimes found floating on the sea, and is occasionally extracted from the rectum of whales in the South Sea fishery. It has a grey-white color, often with a black streak; has a strong, but rather agreeable smell, a fatty taste, is lighter than water, melts at 140° Fahrt., dissolves readily in absolute alcohol, in ether, and in both fat and volatile oils. It contains 85 per cent. of the fragrant substance called *ambreine*. This is extracted from ambergris by digestion with alcohol of 0.827, filtering the solution, and leaving it to spontaneous evaporation. It is thus obtained in the form of delicate white tufts: which are convertible into ambreic acid by the action of nitric acid. Ambergris is used in perfumery.

CANDLES.

The consumption of Candles in the colonies, where gas is only in very few instances employed for purposes of illumination, is necessarily larger in proportion to the population, than at Home, where the candle is almost

entirely superseded by other illuminating agents. For instance, New Zealand pays about £80,000 per annum for candles; an amount which gives to the subject of colonial manufacture of candles, considerable importance. The candles that have been hitherto manufactured in this, and the neighbouring colonies, are chiefly of the common tallow kinds, made by a simple process, and with but little attention to the production of an article to compete in quality with the imported candles. Considering that a plentiful supply of the raw material exists in the colonies, it is a matter of surprise that attempts have not been made to extend the manufacture of candles, and to produce the improved varieties imported so largely. The specimens in the Exhibition are common moulded tallow candles with unplaited wicks, quite equal to the similar class of candles manufactured in England, but very much inferior for general use to the stearine or sperm candles imported. Without entering into the details of the manufacture of candles, a brief reference to the chemistry of fats and oils may be made with advantage.

Most fats and fixed oils, vegetable and animal, are mixtures of two, and generally three distinct compounds, each of which singly has all the properties of fats. The first of these substances, called *stearine*, is solid at common temperatures; it constitutes the solid fatty ingredient in mutton tallow; the second is *oleine*, and is liquid at ordinary temperatures, and down to the temperature of freezing water; the third substance is named *margarine*, on account of its mother-of-pearl lustre, and is solid at ordinary temperatures. All fats, therefore, may be regarded as mixtures of the fluid *oleine* with the solid *stearine*, or *margarine*. If the solid be in larger proportion than the fluid, as in various kinds of tallow, it requires a greater degree of heat to melt it. If the fluid proportion prevails, as in the oils, the melting point is lowered.

Each of these three substances contains an organic base, or substance capable of uniting with acids to form (in most cases) a neutral compound. This base is named *glycerine*, or *hydrated oxide of glyceryl*, and is united with an unctuous substance which has acid properties. The glycerine is common to all the three fatty principles, but the acid in each has its own peculiar characters. Thus the acid in *oleine* is named *oleic acid*, which, combining with the oxide of glyceryl of the stearine, forms *stearate of glycerine*. Again, the acid of *margarine*, is called *margaric acid*; this combining with the oxide of glyceryl of the margarine, forms *margarate of glycerine*.

All these fatty compounds are decomposed by free alkalies, such as

potash and soda; their acids quitting the glycerine to unite with the alkalies, forming a soluble soap, while the glycerine is left behind in the mother liquor. The hard soaps of commerce, when made with oils (palm and cocoa-nut oils excepted) are chiefly mixtures of oleate and margarate of soda, with little, if any, stearate. When the hard soaps are made with animal fats, they are mixtures of oleate, stearate, and margarate of soda.

Considerable improvements have been made of late years in the manufacture of candles, by decomposing the fatty, or oily substances used for the purpose, and employing the *stearine* (stearic acid) only. The first process consists in destroying the combination of the fatty acid with the glycerine by means of lime which displaces it, whereby stearate, margarate, and oleate of lime, are produced in the form of solid soap, and the glycerine, set at liberty, is dissolved in the water necessary to determine the combination. The lime used must be as caustic as possible, and be thoroughly incorporated with the fat. For this purpose, about 1,100 lbs. of fat are placed in a vessel of wood, slightly conical, and of the capacity of about 100 gallons, together with a quantity of water, sufficient to dissolve the glycerine; this will be about 50 gallons. The temperature of the whole is raised by introducing a jet of steam into the vessel, and when the fat is melted, about 170 lbs. of lime, well mixed up with water, are added, and the whole well stirred up until the chemical changes shall have been effectually produced. The next process is to separate the lime from the fatty acids, which is effected by means of dilute sulphuric acid. The fatty acids are next washed with pure water, and formed into solid cakes, which are afterwards subjected to high pressure and heat, for the removal of the oleic acid. The solid stearic and margaric acids are again pressed, after which they appear of a brilliant white, and form more than 45 per cent. of the fat employed. Lately the process of saponification has been improved and simplified, by the use of sulphuric acid instead of lime.

The following are the exhibits of Colonial-made Candles:—

Auckland.

Messrs. Allender and Stevenson, and Messrs. Warnock Bros., send boxes of mould Tallow Candles, the merits of the article in each case being equal. The candles are an excellent sample, of good colour, and not so soft as many home manufactured candles are.

Tasmania.

Messrs. Murdoch and Murray exhibit mould Candles of good quality and manufacture.

SOAP.

The manufacture of Soap in this and the neighboring Colonies has extended considerably of late years, and in many cases the local production has superseded the imported article in the market. The samples of soap exhibited by various Colonial manufacturers are exceedingly creditable, and make it a matter of surprise that New Zealand alone should expend nearly £21,000 per annum in the purchase of imported soap. The Colonial manufacturers have hitherto chiefly, if not entirely, confined themselves to the manufacture of the common yellow soap, but there is no reason why they should not extend their operations to fancy kinds. Soft soap is manufactured in Australia by one or two firms, but no samples of this description were forwarded for exhibition. The hard soaps exhibited are made from tallow and soda, much in the same way as in England. The samples appear to be very pure, and free from the adulterants so much employed by English manufacturers.

Auckland.

Messrs. Warnock Brothers, of Auckland, show samples of Yellow Soap of their manufacture. It is more yellow in color than the soap of other Colonial makers, owing doubtless to the admixture of resin with the alkaline ley.

Wellington.

J. Cummings, of Wanganui, exhibits two boxes of excellent Brown Soap, in capital condition.

Canterbury.

John King, manufacturer, Christchurch, sends a quantity of "extra pale" Soap, the price of which he fixes at 42s. per cwt. This soap is more attractive to the eye than the other specimens, and is of good quality. It is a mistake to suppose that in *all* cases the pale soaps are purer than the browner kinds; and, without questioning the genuineness of this sample, to which an Honorary Certificate was awarded, we may quote the following remarks from the Jurors' Report on Soaps in the International Exhibition, 1862:—"There is still an unfortunate tendency to adulteration, owing in a great degree to the ignorance displayed by the public in preferring light-colored soaps, as being in their opinion the purest; consequently, in order to gratify this mistaken judgment, the soapmaker has to reduce the quality of a pure soap of rather brown color by the copious admixture of salt and water, or other adulterants."

Otago.

The sample of Brown Soap exhibited by Moses Bardsley, of Dunedin,

is of very good quality, rather dark in color, but a genuine, good-conditioned soap.

Tasmania.

Murray & Murdoch, Hobart Town, exhibit a box of Yellow Soap of good quality.

South Australia.

W. H. Burford, Adelaide, shows samples of Yellow Soap, quite equal to anything of the kind in the Exhibition.

It is worthy of remark that the increasing disposition of our wool-producers to ship their wool in the washed state, should induce our local manufacturers of soap to produce a soft or potash soap for the use of the wool-scourer.

Of Toilet and Fancy Soaps, the only Colonial exhibitor is J. W. Tatton, Nelson, who shows samples of white and marbled soaps of his own manufacture. Toilet soaps are usually prepared by remelting and clarifying curd or white soap, and adding various perfumes, colors, &c. The *marbling* of fancy soaps is produced by rubbing up the coloring material, such as vermillion or ultramarine, with a little olive oil or soap, and taking a small portion on a palette knife, it is pushed through the melted mass, and moved about according to the taste of the operator.

Eugene Rimmell, London, exhibits Fancy Soaps of the various kinds for which he is so widely celebrated.

HONORARY CERTIFICATES.

33. WARNOCK BROTHERS, Auckland—Excellence of Soap and Candles.
414. JOHN KING, Christchurch—Pale Soap.
203. J. CUMMINGS, Wanganui—Soap.

CLASS IV.

Sub-Class B.—OTHER ANIMAL SUBSTANCES USED IN MANUFACTURES.

Section I.—WOOL.

JURORS.

WM. LOGIE	JAMES GARDINER
M. S. GLEESON	J. LAUSEIGNE.

WOOL is undoubtedly one of the most important productions of New Zealand, and its value in export is only second in annual amount to that of gold. In order that this subject should receive the best attention, the Commissioners appointed an Associate Committee for Wools, consisting of the following gentlemen :—

Henry Driver, Esq.	F. D. Rich, Esq.
William Logie, Esq.	J. M. Robertson, Esq.
Pierce Power, Esq.	Campbell Thomson, Esq.

W. H. Lees, Esq.

Through the exertions of the Committee, seconded most heartily by wool-growers from all parts of the Colony, a collection of specimens has been obtained which forms one of the most interesting as it is undoubtedly one of the most valuable features of the Exhibition.*

* The following Instructions with regard to wool were extensively circulated by the Commissioners through the various Local Committees and Agents :—" Wool.—It is desirable that wool should be exhibited, if possible, in whole fleeces, and the following information supplied :—By whom shown? As owner or breeder?—Breed of animal?—Age?—Sex?—Where bred?—By whom?—If imported, date of importation, whence from, and age when imported?—Date of this shearing?—Date of previous shearing?—When washed, and how, previous to this shearing?—If ever diseased?—When dipped, and materials used for dipping?—Weight of fleece?—Length of staple?—If stapled, varieties of wool into which it is classed, with their respective weights?—Price, average realised for previous clips of same flock?—Where sold, and how? "—Ed.

The exhibitors of wool numbered forty, many of whom furnished a number of specimens of the various varieties of wool. The exhibits comprised every description of wool cultivated in the Colony, thus illustrating at one view the progress and improvement that have been made in this important branch of colonial production. The principal Provinces of New Zealand were well represented. Although there was a fair number of fleeces shown, the Jury very much regretted that in numerous instances exhibitors had merely sent locks upon cards, rendering the samples unavailable for examination. It was a matter of surprise to the Jury that the Wellington exhibitors, with only one exception, should have adopted this unpractical method of displaying their wools, particularly as it cannot be pleaded in excuse that any difficulties existed in the way of sending entire fleeces. It need hardly be stated that small locks of wool are utterly unfit for the purposes of exhibition, as it is impossible a confident opinion can be expressed concerning the merits of wool thus exhibited. Even single fleeces are not a safe criterion by which to judge of the character of a whole clip, and this is a fact so well understood by persons engaged in the wool trade, that the Jury are quite at a loss to account for the Wellington exhibitors having overlooked it. After considerable discussion, and with a conscientious desire to do justice to exhibitors, the Jurors most reluctantly felt compelled to decline any inspection of wool samples when not shown in the fleece. The regret unanimously felt was increased by the consideration that this decision would have the effect of shutting out from competition nearly the whole of the exhibits from Wellington, and more especially the elaborate series of samples shown by Mr. Ludlam of that Province. Whilst fully recognising the valuable services rendered to wool-growers by this breeder, the Jury could not venture to express an opinion on the samples exhibited, which, as before stated, were quite insufficient on which to form any decision. The difficulty in which the Jurors found themselves was intensified by the evident desire on the part of the Commissioners that the Jury should reconsider their decision as to the inspection of samples on cards, but the discussions on the subject failed to convince the Jurors of the propriety of departing from the course they had laid down.

Of course the Jury considers that the services of such intelligent breeders as Mr. Ludlam and Mr. F. D. Rich are worthy of recognition. These gentlemen are undoubtedly entitled to the thanks of the whole wool-growing interest for their exertions; and the Jurors hear with pleasure that it is the intention of the Commissioners to award medals to

those who have prominently assisted in the promotion of Colonial industry. From the number of exhibits of long wool, or of wool from crosses with long wooled animals, the Jury conclude that the cultivation of wool for combing purposes is growing more into favor; and, judging from the excellent quality and great weight of fleece of the samples shown, this branch of wool-growing will doubtless become an extensive and profitable one. Of late years the demand for combing wools has vastly increased, and is apparently limited only by the supply, which is not equal at present to the wants of the British manufacturers.

In 1861, the Wool Supply Association of the Bradford and Halifax Chamber of Commerce issued a circular, addressed to "all parties interested in the growth of Colonial and other foreign wools," a portion of which is worthy of insertion in this Report. It is as follows:—

"The increase in the Worsted Trade of Great Britain has been very considerable during the last few years, and its further development has been checked only by the difficulty of meeting with an adequate supply of long wool.

"To meet this condition of things, and in order, if possible, to increase the supply, the Wool Association is desirous of disseminating information in the wool-growing districts.

"The increase in the imports of foreign wool during the same period has been very large; but these supplies were almost exclusively of a nature to adapt them to the woollen rather than to the worsted manufacture. Those interested in the latter branch of industry are anxious to stimulate the growth of wools suitable for their wants. The qualities they require give to the wool a higher marketable value for all purposes of manufacture, and are therefore well deserving the attention of growers, collectors, and shippers of wool.

"The wool (the increase of which they desire to promote) should have a staple from four to seven inches long, according to its fineness, and should, as far as possible, be uniform in quality throughout its whole length, bright and lustrous in appearance, or soft and kind to the touch, of good spinning properties, and free from burrs or other vegetable fibre. It should also be well washed before it is clipped; or when this is not practicable, care should be taken that it be not cotted or felted in drying. It is most desirable to retain the whole natural length of the staple by only clipping the lambs or sheep once during the season's growth, unless local causes render it absolutely necessary to do so oftener.

"It is also very desirable that a proper classification of wool should be

made in packing, and that the packing should be thoroughly trustworthy and fair.

"An improvement is already manifested in the wool of some countries, and the Association believe that it might be made general, if proper care were taken in the selection of breeding sheep, particularly of the rams, and, where necessary, by the introduction of new blood."

The exhibits of fine wools are not so numerous as might have been expected, but some are of superlative excellence, both as to quality and length. The evidences of attention in the matter of careful breeding are not wanting, and the quality of the merino wools is as a whole equal to anything that the Jury have ever witnessed. The Provinces of Nelson, Marlborough, and Taranaki, were unrepresented in the Exhibition; which is to be regretted, as there are many careful and eminent breeders in the former provinces, and Taranaki is favorable to the cultivation of the long-woolled English varieties.

The following statistics shewing the rapid progress of the Wool production of New Zealand, are compiled from the Official Returns published by the Colonial Government.

Comparative Table Showing the Number of Sheep in the possession of Europeans in the several Provinces of New Zealand in the Years 1851, 1858, 1861, *and* 1864 *respectively.*

	1851.	1858.	1861.	1864.
Auckland	11,075	58,792	67,803	73,151
Taranaki	2,700	16,000	10,566	12,850
Wellington	64,009	155,994	247,940	411,502
Hawke's Bay	....	180,320	312,459	537,094
Nelson, including Marlboro' in 1851-8	92,014	393,041	181,367	341,281
Marlborough	....	....	368,836	456,374
Canterbury	28,416	495,580	877,369	1,567,733
Otago, including Southland in 1851-8	34,829	223,597	619,853	1,300,413
Southland	....	....	73,990	235,056
Chatham Islands	....	....	....	2,319
TOTALS	233,043	1,523,316	2,760,163	4,937,233

The specimens of scoured wool attracted special attention, and the opinions of the jurors in their remarks on the several exhibits, are directed to the character of the *scouring* in each case, and not to that of the wool.

The following Table shows the Quantity and Value of Wool Exported from New Zealand from 1853 *to* 1864 *inclusive.*

	QUANTITY	VALUE.
	lbs.	£
1853	....	66,507
1854	....	70,103
1855	1,772,344	93,104
1856	2,559,618	146,070
1857	2,648,716	176,579*
1858	3,810,372	254,022
1859	5,096,751	339,779
1860	6,665,880	444,392
1861	7,855,920	523,728
1862	9,839,265	674,226
1863	12,585,980	830,495
1864	16,671,666	1,070,997†

Wool is defined by Professor Owen to be "a peculiar modification of hair, characterised by fine transverse or oblique lines, from 2,000 to 4,000 in the extent of an inch, indicative of a minutely imbricated scaly surface when viewed under the microscope, on which, and on its curved or

* The value of Wool exported in 1857, 1858, 1859, 1860, and 1861, was calculated at the uniform rate of One Shilling and Four-pence per lb., but the subsequent Returns are taken at the value declared to the Officers of Customs by the respective exporters.—ED.

† For the Quarters ending 31st March, and 30th June, 1865 (latest published accounts) the Returns give the following as the Exports of Wool:—

1865.	1st Quarter ..	14,754,503 lbs.	...... Value	£881,602
	2nd „	3,240,540 „	...... „	188,144
		17,995,043 lbs.	Value	£1,069,746

Corresponding Quarters of 1864—

1864.	1st Quarter ..	10,613,852 lbs.	...... Value	£679,308
	2nd „	4,905,276 "	...... „	316,117
		15,519,128 lbs.	Value..	£995,425

—ED.

twisted form, depends its remarkable felting property, and its consequent value in manufactures." According to Milburn, wool contains 98 per cent. of organic elements, and 2 per cent. of ash. The former consists of: carbon, 50·65; hydrogen, 7·03; nitrogen, 17·71; oxygen and sulphur, 24·61 = 100. "The ash contains oxide of iron, sulphate of lime, and phosphates of lime and magnesia; so that sulphur is a very important element in the composition of wool. Some close statistical calculations have been made, which show that in the United Kingdom as many as five millions of pounds of sulphur are annually abstracted from the soil by the sheep. It is evident, therefore, that in order to have healthy animals, and a full produce of wool, there must be in the soil a good supply of sulphur, nitrogen, potash, and phosphorus; or the land will not enable the animal to secrete wool in perfection."

Wool is divided into two chief classes, *combing* wool and *clothing* wool. Some manufacturers want fine clean wool only; others, lower qualities, but still clean and even; others, lambs' wool; others, greasy; others, black or grey locks and pieces; each according to the several articles they manufacture;—as, for instance, young sheep's, and all long-grown staple wools are bought by those who comb them for bombazines, camlet, &c. The short stapled and weak-grown old sheep's wool can only be used by manufacturers of broadcloth and fancy goods. The short wools are of no use to other manufacturers, and long wools cannot be used for such purposes as require only wools of shorter growth; so that when combing and clothing wools are packed in the same bale, well-washed and ill-washed lambs' wool, and locks and pieces, or any other kind of irregularity appears in opening the bales for inspection before sale in the warehouses, they are passed over by the buyers of evenly-packed wools, as not suiting their purposes in that mingled form. The importance of careful sorting cannot therefore be exaggerated.

Washing and Scouring.—These are operations the importance of which cannot be too highly estimated, for by the efficient or defective manner in which they are performed the value of the wool is enhanced or deteriorated. It has been a long standing complaint with English manufacturers that the New Zealand wool is sent home in a dirty condition. Owing to this defect in preparation, the New Zealand wools, although fully equal, and in many instances superior, to the Australian in quality, have not commanded so high a price as they would have done if greater pains had been taken in washing the sheep. This fact has been often and constantly impressed on the New Zealand wool-growers, and within the

last year or two a great improvement in this respect has taken place. The plentiful supply of the purest water which abounds in every district of New Zealand, makes it a matter of surprise that the very necessary operation of washing has been so much neglected, or at least attended to in a very indifferent manner. The improvement which, as before stated, has taken place with regard to the preparation of the wool for sale, is fully demonstrated in the fleeces shown in the Exhibition. Still, the difference discernible in the cleanliness of the wool from different stations, shows that many of our wool-producers may yet with advantage pay greater attention to the subject of washing. The apparent high price obtained for some of the wools exhibited, is attributable not so much to the extra quality of the wool as to its cleanness. It stands to reason that a manufacturer will give more for wool that is clean than for ill-conditioned wool. On this subject of washing, the following remarks, which appear in the *Catalogue of the Exhibition of Animal Products in the South Kensington Museum*, are worthy of attention :—

" With regard to washing sheep, it is often supposed that the water is used simply to dissolve the dirt in the fleece, and by its mechanical action to separate it from the fibre ; but this is really the smallest part of the good sheep-washing does. On the finer-woolled sheep, especially, a yellow exudation may be noticed near the skin. It is seen nearly all over good sheep, but most on the breast and shoulders. Now, this is a secretion from the glands of the skin, and serves, it is supposed, an important purpose in refining the fibre, and protecting the animal. This yellow gum, called "yolk," from its resemblance to the yolk of an egg, is chiefly composed of potash and oil. It is, in short, a sort of naturally-formed soap, which when the sheep is plunged in the water, is dissolved, and acts as a powerful cleanser of the whole fleece. It is as if fine soft soap had been intimately mixed with the fleece down to the very skin, just before washing the sheep. The owner of sheep who keeps this fact in mind, will see the importance of the following things :—1. He will do well to wet the sheep, and let them stand a little while before he washes them thoroughly. This will allow the soap of the yolk to act freely.—2. If he can wash his sheep in clear soft water, this will be better than hard water. —3. He will find it good for this, as well as for other reasons, to wait till the weather is mild and the water more tepid, for the soap acts better thus than if the water is very cold.—4. He will see the importance of sheltering the flock from long and severe rains. These dissolve the yolk, and lower the quality of the wool, besides chilling and weakening the sheep themselves."

With regard to the *scouring* of the wool after shearing, the Jury are of opinion that it is a mistake on the part of the Colonial scourers to attempt the production of a very high color, to the sacrifice of some of the most important essentials of the wool. Many of the samples of scoured wool were completely spoiled either by the too free use of some chemical agent, or some other cause, which produced a harsh dryness in the wool that must materially affect its value. As none of the samples, however white, are in a state to render further scouring unnecessary by the manufacturer, the point that should be aimed at should be to produce a clean well washed wool, but still retaining the natural character of the wool.

In only a very few instances did this desirable result appear to have been accomplished. The excessive scouring displayed in the majority of the samples is most undesirable and unprofitable to the exporter, as well as injurious to the wool itself. The Jury are firmly of opinion that *well washing the sheep before shearing* is amply sufficient for all purposes until the wool reaches the hands of the manufacturer. Where scouring is resorted to it is of paramount importance, especially with combing wool, that the staple should be kept free and open, and not felted or matted together. In some of the samples exhibited, the wool was so cotted as in reality to destroy its combing quality. This is a very serious evil, and one that entails loss on the grower by the reduced prices he can obtain for such wool.

The excessive use of alkalies is most objectionable in the scouring of wool. Soap is extensively used by the scourers at home; and it is worthy of notice that by the saponification of the greasy water after the wool has been scoured, the ingredients are again utilised. With reference to the kind of soap most suitable for wool-washing, it is worthy of notice that the Victorian Commission on New Industries recently awarded a prize to Messrs. Hood & Co., of Melbourne, for soft soap manufactured specially for this purpose. The following remarks on this subject, recently addressed by Messrs. Hood & Co. to the Melbourne *Argus*, appear to merit the attention of wool scourers:—

"The ordinary hard or soda soap which has been hitherto used in these Colonies for washing wool, is never used in any other country of the world for that purpose. It is not easily enough soluble, nor sufficiently detergent to cleanse the wool properly. In all other countries, soft or potash soap is used, both on account of its great solubility, which brings its ingredients into contact with every particle of the wool and its impurities, and also by reason of its great detergent or thoroughly cleansing

qualities. Potash soap thoroughly searches the wool, and completely purifies it. This is owing to its greater softness, which it derives from its peculiar alkaline base—potash, and not from its oleaginous or fatty base, whether this latter be oil or tallow. Soaps are made of various fats or oils in conjunction with an alkaline base. If the alkali used is soda, the result is a hard soap; if potash, the soap is soft. Soft soap acts in harmony with the "yolk" of the wool, which chemistry has long since proved is itself a natural pure potash soap."

LONG WOOLS.

Of the English *Long Wools* introduced into New Zealand, the *Lincoln*, *Leicester*, *Cotswold*, and *Romney Marsh*, may be considered as the best known types, to which may be added, as a sort of intermediate class, the *Cheviot*. The *Lincoln* is generally accepted as the standard type of the coarser wools, suitable for combing purposes. This wool combines many qualities essential for the branch of manufacture in which long wools are employed. It is of great length, and possesses that peculiar silky gloss which renders it specially adapted for the manufacture of "lustre" goods, and is used, also, largely in fabrics in imitation of alpaca and mohair. The demand for this class of wool has increased largely of late years, owing to the production of the particular goods just mentioned, and its price has consequently become enhanced. It is a class of wool, to the production of which the soil and climate of New Zealand are very suitable, as the excellent specimen of Lincoln wool exhibited by Mr. Matthew Hill, (1655) of Hawke's Bay, satisfactorily proves. In fact, it may be asserted as a rule, that the long-woolled sheep, of Great Britain, improve with the change; the length of the wool is increased, and all its valuable properties preserved, owing doubtless to the genial climate, and the absence of exposure to the extremes of an English temperature.

Scarcely second in repute as a combing wool, is the *Leicester*. This wool is somewhat finer than the Lincoln, but the staple is not quite so soft and silky. Still, it is a wool that commands almost as high a price as the Lincoln, and is in great demand for certain classes of woollen goods. Of all the long woolled sheep, the Leicester has received the most attention in New Zealand, and the success which has attended the efforts to introduce its production in this Colony, affords every encouragement to the promoters, and there can be no doubt that in a few years the growth of Leicester wool will be largely prosecuted. There are many splendid samples of Colonial grown wool of this class in the Exhibition, and a comparison of the respective merits of the English wool, as shown in the

on the plains towards the South. The excellence of the wool, to which everything else is sacrificed, is supposed to be due to an equality of temperature maintained by shifting the position of the sheep. But an objection to this explanation arises from the fact that the fleece of some of the German Merinos, which do not travel at all, is far superior to the best Leonese fleece; and, even in Spain, it is said that there are stationary flocks which produce wool equal in quality to that of the migratory ones. The average weight of the fleece in Spain is about 8 lbs. from the ram and 5 lbs. from the ewe.

About the year 1765 the Merino sheep was introduced into Saxony, and after some years became naturalised there; the breed of Saxon sheep was also improved by crossing, and the Saxon fleece soon became superior to the Spanish in fineness and manufacturing value. Great attention is paid to wool in Germany, where large flocks are kept for their wool alone. The utmost care is taken of the sheep; in some instances they are kept for months in large barns and jealously protected from dew or rain. In the King of Saxony's flock wethers are kept to the age of nine or ten years solely for the 2 lbs. or 3 lbs. of wool which they annually yield. So important is the proper selection of breeding animals considered in Germany, that the best flockmasters do not trust to their own judgments or that of their shepherds, but employ persons called "sheep classifiers," who make it their special business to attend to this part of the management of several flocks, and thus to preserve, or, if possible, to improve the best qualities of both parents in the lambs. The ordinary flocks in Saxony produce very fine wool, but much less in quantity than those of the improved breed; the first yielding from 2 lbs. to 2¼ lbs., worth from 2s. 6d. to 3s. 6d. per lb.; whilst the flocks of others yield from 2½ lbs. to 3¾ lbs., worth from 3s. 6d. to 4s. 4d. per lb.

In 1787 a small flock of Merinos from the borders of Portugal was received in England, but it was not until 1791 that the pure Spanish Merino was introduced into England. Application was made by George III. to the King of Spain, for permission to select sheep from one of the best flocks: this was granted, and a number of sheep of the valuable Negretti breed, which the law of Spain had hitherto prevented being exported, arrived in England and were transferred to Kew. In this, as in other cases, the experiments were successful. After a few crossings on the Wiltshires, the ewes became hornless; they had acquired the shape of the Merino; the wool had increased from 3½ lbs. to nearly 6 lbs. per fleece, and was scarcely inferior to that of the pure Spanish sheep. The

prejudices of the English sheep-farmers, however, opposed great obstacles to the general introduction of the merino; and although, through the exertions of the "Merino Society," of which Sir Joseph Banks was President, a certain amount of enthusiasm was created on the subject, the farmers preferred to grow mutton to wool, and the cultivation of the merino languished and ultimately became almost entirely neglected.

In 1797 the merino was introduced into Australia by Captain John M'Arthur, who took out from England three merino rams, and five ewes. But it was not until 1807, that the first sample of wool was shipped to England. Of the rapid increase which took place in that Colony little need be said further, than that the export of wool from the Australian colonies in 1861, exceeded seventy millions of pounds. From New South Wales the merino was successively introduced into Victoria, South Australia, Tasmania and New Zealand, in every case with marked success, but each change of climate and soil producing a distinctive character of wool. The merino wool has become finer and softer in Australia, and in New Zealand the length of staple and weight of fleeces have been increased, without any deterioration in the quality of the wool. The German merinos have also been cultivated, with remarkable success, in the Australian colonies, judicious crosses with which have materially improved the character of the wool of the Spanish merino.

Foremost amongst the breeders and importers of pure blooded merinos in New Zealand, stands Mr. Rich, who, as well as his late father, Mr. George Rich, of Auckland, has done more to improve the breed than any person in the Colony. The celebrated Mount Eden flock of this breeder, enjoys a most extraordinary and well-deserved popularity throughout the Australasian colonies. In the establishment of this flock everything has been done that could be done, by importations of the very best European blood, and the greatest care in the cultivation of colonial bred sheep. The fleeces exhibited by Mr. Rich prove what can be accomplished by scientific culture; the great weight of some of these merino fleeces is astonishing—21 lbs., 16 lbs., 20 lbs., 15 lbs., 10½ lbs., and 7 lbs., being the weight of one year's growth fleeces in Mr. Rich's exhibits. When we consider that with this great weight of wool, is combined the utmost fineness of fibre of the original Spanish merino, the great value of Mr. Rich's breed becomes at once so apparent as to need no further comment. It is related, that so much has Mr. Rich improved the original blood, that some of his rams have been exported to Europe. When the late Mr. George Rich was on a visit to Europe for the purpose of inspect-

ing the finest flocks of the Continent, he showed some samples of his Mount Eden wool to Baron Damier, Superintendent of the Imperial French Merino flock at Rambouillet, and the Baron was so struck with the superiority of this wool, that he requested Mr. Rich to send him a few of his rams, in order to improve even the famous "Rambouillet" flock.

The New Zealand Sheep Runs have been stocked chiefly with the Australian-Merino variety, improved through the importation of pure Saxon Merino rams from Germany. A few rams of the celebrated Rambouillet flock have also been imported, and specimens of the wool of this kind are exhibited by Mr. J. Hassel, of Oamaru, from animals imported by Messrs. Campbell and Low, of Benmore Station. Although there is every reason for believing that the growth of long wools will be largely increased, the merinos will always occupy the chief position in the flocks of the Colony. The excellence of the merino consists in the unexampled fineness and felting property of its wool, which in fineness and in the number of serrations and curves exceeds that of any other sheep the world produces Fine Saxon-Merino wool has 2,720 seriations in an inch; Merino wool, 2,400; Southdown wool, 2,000; and Leicester, 1,850;—these figures represent the felting properties of the various wools. The wool of the merino is close, and the luxuriance of the "yolk" enables them to support extremes of cold and wet as well as any other breed. The merinos adapt themselves easily to every change of climate, and thrive and retain, with common care, all their fineness of wool under a burning tropical sun, and in cold mountain regions.

ALPACA.

The *Alpaca*, although not coming strictly within the list of *wool*-producing animals, deserves a notice in this place, the more particularly as it has already been introduced into several Provinces of New Zealand. A few animals purchased from the New South Wales Government, and which formed part of the flock originally brought from Peru by Mr. Ledger, have been imported into Auckland, Welliugton, and Nelson. The New Zealand climate, and particularly that of the Middle Island, is considered well-suited to the Alpaca, which inhabits the Cordillera or mountain districts of South America,—is of hardy nature, and can pick up feed where other animals would starve. The Alpaca belongs, with other varieties of the same species, to a tribe of animals, natives of South America, the wool of which was formerly extensively used by the ancient Peruvians. Through the energy and enterprise of a large English manu-

facturer, Mr. Titus Salt, of Bradford, the wool of the Alpaca has been largely imported into Great Britain, and made known throughout the civilised world. The family of animals yielding this wool is allied to the camel and the dromedary, and are all referred to one genus, Llama, and are known as follows :—

1. *Llama Pacos*—the Alpaca.
2. *Llama Glauca*—the Llama.
3. *Llama Vicugna*—the Vicuna.
4. *Llama Guanacas*—the Guanaco.

The Alpaca, has a very long hair or wool, six to twelve inches long, and finer than silk; most of the animals are black as jet; some are white; others brown, grey, or mottled. Specimens of the wool of various colors are shown by the Bradford Wool Association (1665), and a sample of black Alpaca wool from the recently imported animals, is exhibited by the owner, Mr. D. Graham, of Auckland.

The Llama has a short coarse wool, and but little is exported from Peru.

The Vicugna, the smallest species of the Llama family, has a short downy kind of wool, of a pale reddish brown. The Vicugna wool is more difficult to be procured, from the nature of the animal. It is wild, and grazes on the tops of the highest mountains of the chain of the Cordilleras, sometimes 15,000 feet above the level of the sea. In the time of the Inças, the Vicugna was a domesticated animal. Latterly, owing to the demand for its wool, the animals are much more taken care of than formerly by their owners, the Indians, and have greatly increased in number.

The Guanaco, is smaller than the alpaca, and yields a coarser hair of a dark brown or pale red color.

Attempts have been made with moderate success, to cross the breed of the alpaca with the vicugna. The wool thus produced is even more soft than that of the vicugna, and of a more silky texture. The Peruvian Government jealously protects the growth of alpaca wool, and prohibits the exportation of the animals. This restriction has however been occasionally evaded, and the Government has also permitted a limited number of animals to be exported to Australia. This concession has been acquired through the exertions of Mr. Duffield, who has interested himself in the introduction of the alpaca into Australia, and incurred great loss in so doing. Of a cargo of animals, more than three-fourths died on the passage. Mr. Duffield is, however, determined to persevere, and other

attempts will be made. Should the alpacas already in New Zealand be found to thrive, no doubt efforts will be made to promote the introduction of the animal into every province.

Auckland.

1602.—Charles Shipherd, breeder, shows a fleece of Leicester wool, weight when shorn, 10 lbs. Average of flock last year 8 lbs. Wool sold in England at from 2s. 2d. to 2s. 5d. per lb. The same exhibitor also furnishes nine samples of long wools of the Leicester breed, many of which maintain the true character of this breed, and illustrate beyond question the suitability of the Auckland climate for this description of sheep.

1603.—Thomas Shipherd, breeder. Fleece of Leicester wool, length of staple, 13 inches; but much cotted.

1604 to 1606.—B. W. Gee, exhibits two cases of scoured wool, upon which the Jury must express severe condemnation—qualified only by the hope, that the exhibitor does not profess to be practically acquainted with the wool business. In the first place, the wool is absurdly over-scoured, and converted almost into a brittle hair; and, in the second place, the tips of the wool have been cut away. Altogether the exhibits, especially one case, of apparently Leicester Lambs' wool, ought never to have been admitted into competition.

1609.—John Grigg, Otahuhu, breeder, shows a good many samples of long wools, viz., one fleece of Leicester, and eleven card samples, one case of Leicester, and two cases of washed ditto. The Leicester wool is of very superior quality, long and lustrous, and decidedly the best sample of this description of wool exhibited in the Auckland collection. The washed wool, however, betrays a want of that attention to the preservation of the openness of the staple so imperative with wools of this class.

1621-1622.—Two cases of wool, without designation or name of exhibitor. Inferior in every respect, and hardly worth a place in the Exhibition.

1652.—A. J. Allom, breeder, exhibits, fleeces of cross bred long wool of considerable merit, great length, and fair quality, but the cross does not exhibit anything very desirable on any point.

1654.—R. Grahame, breeder, shows a fleece of Leicester wool of very superior quality.

Hawke's Bay.

1655.—Matthew Hill, breeder, exhibits two fleeces of long wool, from imported Lincoln ewe, bred by Thomas Kirkham, Louth, Lincolnshire

weight of fleece, 13½ lbs.; average price two shillings per lb. This is a true specimen of the most valuable of all long wools.

1656.—J. Rhodes, breeder, shows two fleeces of Leicester wool of good character.

1651.—J. Hislop, exhibits, fleeces of a very valuable description of cross-bred long wool: the cross not mentioned by exhibitor.

1659.—Major Whitmore, exhibits a fleece of well bred Leicester wool.

Wellington.

1658.—George Hunter, exhibits a most interesting and valuable series of specimens of cross-bred wools, including crosses of Cotswold and South Down, Cotswold and Merino, and Cotswold, South Down and Merino. The most successful cross appears to be the Cotswold, South Down and Merino,—the wool of this breed combining so many very important and valuable qualities. The Cotswold and merino is undoubtedly a good cross, of which the excellent quality of the wool exhibited by Mr. Hunter, is sufficient proof. The specimen fleece of the Cotswold and South Down cross, does not betray much of the South Down character, so that no accurate judgment can be formed of its merits. The following is the list and description of Mr. Hunter's exhibits:—

No. 1. Fleece, Cotswold Ram, ¾ bred—a very valuable description of long wool.

No. 2. Fleece half-bred Cotswold and South Down. There is so little trace of South Down discernible in this fleece that the value of the cross cannot be fairly estimated.

Nos. 3 & 4. Fleeces of half-bred Cotswold and Merino. These must be considered as very extraordinary specimens of this cross, particularly No. 4; the fine texture of the Merino is preserved without detracting from the length of the wool.

No. 5. Fleece of half-bred Cotswold, of half-bred South Down and Merino. One of the most valuable fleeces in the Exhibition, on account of its extra length of staple, closeness of fibre, and in still preserving much of the lustre of a long-woolled cross.

Nos. 6 & 7. Half-bred Cotswold and Merino. Two fine specimens of this cross, showing more clearly the character of the cross than anything we have seen previously. The fineness of the Merino is combined with the extreme length and soundness of staple of the Cotswold.

Nos. 8, 9, & 10. South Down Rams, yearlings. The superiority of these South Downs is fully shown in the crosses from this stock by the same breeder.

1623 to 1630.—A. Ludlam, Hutt Valley, Wellington, exhibits sixty-three samples on cards of cross-bred wools, accompanied with complete explanatory notes concerning the various crosses. This collection includes specimens of pure South Down, South Down crosses, pure Romney Marsh, and Romney Marsh crosses. The South Down flock includes pure-bred imported animals, and rams bred in Nelson from imports from the celebrated flock of Mr. Jonas Webb. The Romney Marsh stock was originally imported from England in 1861 and 1864, and consists of well-selected animals of pure blood.*

Owing to the fact that the samples were not in the fleece, the Jury regretted that they could not express an opinion on their merits; and the same remark applies to the remaining exhibits in the Wellington collection.

1661.—Major H. J. Coote exhibits specimens of Negretti wool, from imported animals and sheep bred by the exhibitor from the original stock. These are the only samples of this valuable breed of wool in the Exhibition; the original stock was bred at Ranzin Moleön, Pomerania, and imported into Canterbury a few years ago. The fleeces average a great weight, viz. 8½ to 9 lbs. The Negretti is a very fine description of wool, and bears a great reputation. Some of the Negretti bred in Mecklenburg and Pomerania average 4 lbs. per fleece, worth 3s. 6d. per lb.; and many rams yield from 8 to 10 lbs. of washed wool. The New Zealand climate increases the weight of wool.

1662.—Archdeacon Hadfield, Otaki, as manager of the Otaki Industrial School, exhibits twelve samples on cards of Merino wool from sheep bred on the Station, the produce of sheep from the flock Zadegast of Saxony and Fryer of Mecklenburg. Since 1854 no rams excepting pure-bred animals of the breed above mentioned have been used on this Station. The wool averages from 8 to 10 lbs. per fleece.

1663.—E. & C. Pharazyn exhibit 10 samples of Merino wool.

1664.—J. Varnham: two samples of long wool, no pedigree or other definition attached.

Canterbury.

1618.—J. F. Nettleton, Kaiapoi, exhibits a number of specimens of scoured wool, some of which are well got up, others open to the objection of being harsh and unkindly to the feel.

1638, 1640, 1649, 1650, 1653, 1657.—T. D. & H. Lance, Horsley-down Station, are most extensive exhibitors, they having sent more than

* *Vide* Appendix B.—ED.

forty fleeces chiefly of Merino wool, from their several flocks. A character of great excellence pervades the whole collection of wools, and there is evidence of great care and attention in preserving the best features of the Merino blood. The fleeces of Merino are a very valuable description of wool—long in staple, and fine and silky in fibre; and some (1649) are a fine bold description of wool, well suited for combing, and still retaining the desired silkiness. The average weight of the fleeces, cut mostly from 3 year old animals, and 11 months' wool, is 4½ lbs. skirted. The fleeces of Merino lambs, 9 months old, average 2½ lbs.

Messrs. Lance exhibit specimens of Cotswold and Merino wool, which show the value of this cross, and fully maintain the best points of the two breeds.

1619.—Pepperell & Co., Christchurch, exhibit scoured wools, in which the preservation of the freedom of the staple is a praiseworthy feature.

1617.—James M'Ilraith, Homebush Station, exhibits a skin fleece of a Merino wether, the wool being 4 years' growth and of extraordinary length. The breaks in the wool at each year's growth are, however, very apparent.

Otago.

1601 & 1610.—F. D. Rich, breeder and importer, Shag Valley, Otago, deserves especial commendation for the completeness and variety of his exhibits, which comprise samples of wool from all the flocks for which he has become celebrated throughout the Australian Colonies. Case 1601 contains four specimen fleeces as follow, viz.:—

No. 1.—Fleece of imported Merino ram, aged. Animal took the Gold Medal at the Intercolonial Stock Show, Dunedin, 1865.* Weight of fleece, 21 lbs.; 1 year and 3 weeks since previous shearing. This is a very fine silky wool, sound in staple; extraordinary weight of fleece for quality of wool.

No. 2.—Fleece of imported pure bred Spanish Merino, aged. Animal took first prize two successive years in Germany, and was the Champion Ram at Oamaru Show in 1863. Weight of fleece, 15 lbs. A very superior wool, combining extraordinary length of staple with beautiful texture of fibre, and maintaining in every feature the true character of the Spanish Merino breed.

* This Show was held under the management of Messrs. DRIVER & MACLEAN, Dunedin, in connection with the New Zealand Exhibition. Awards of Honorary Certificates were made by the Judges and given by the COMMISSIONERS, in addition to which Messrs. Driver & Maclean very spiritedly provided a number of Gold and Silver Medals, which were also awarded to the successful exhibitors.—ED.

No. 3.—Fleece of imported Merino Ram, aged. Animal took Gold Medal champion prize at Oamaru, 1864, and was First Prize Ram at the Intercolonial Stock Show, Dunedin, 1865. Weight of fleece, 20 lbs.; 1 year's growth. A very superior clothing wool—close, full bodied, but not equal in length or silkiness of texture to the two preceding exhibits.

No. 4.—Fleece of Spanish and French Merino Ewe, aged (with lamb at foot). Weight of fleece, 12 lbs.; 1 year's growth. A very extraordinary specimen of ewe wool, and scarcely to be surpassed for length and strength of staple and general character.

1610.—Mr. Rich also exhibits three fleeces from sheep of his own breeding, viz. :—

No. 1. Fleece of Merino ram, 10½ lbs.

No. 2. Fleece of Merino ewe (with twin lambs at foot.) Animal took Champion prize at Oamaru, 1863. Weight of Fleece, 7 lbs. These two exhibits deserve special mention and attention. No. 1 is a very fine, close woolled, ram, and No. 2, a superior ewe, with a staple of extraordinary length, combined with fineness of quality.

No. 3. A fleece of Leicester ram, weight 16 lbs. Animal took Second Prize at Intercolonial Stock Show, Dunedin, 1865. A superior sample partaking of every quality, length, weight and lustre, desired in this description of wool.

1608.—Douglas, Alderson and Co., Dunedin, breeders, exhibit three samples of scoured wool from Hakateramea Station, consisting of first and second combing, and first clothing wools. These are very superior specimens of Otago wool, as well with regard to condition, as to quality and length of staple.

1634.—C. de V. Teschemaker, Waipahi, breeder, exhibits a skin fleece of Merino ewe, which is undoubtedly the most extraordinary specimen in the Exhibition. The fleece, which is supposed to be about four years' growth, weighs 21 lbs., and has a staple of wonderful length—18 inches of fine wool without a single break, and the fibre equal to the purest Merino.

1631.—Jas. Hassel, Oamaru, breeder, one sample bale of washed wool.

1635.—Renwick & Co., Green Island, exhibit specimens of scoured wools, which, as specimens of scouring, may be considered very creditable. The combing wool partakes of all the desirable qualities that combing wool should present,—is of a good bright color, clean, and the staples well preserved and free from cotts.

1636.—Smith & Co., Tokomairiro, are extensive exhibitors of scoured wool, which on the whole may be regarded as the best samples of scouring in the Exhibition. There are some of the specimens not so well got up as others, in some instances the wool being stained or scorched in drying. Three bales of scoured merino were considered by the Jury as most excellent specimens, and fully justified special mention.

1641.—M'Landress, Hepburn, & Co. exhibit fleeces and samples of wool as follow:—Specimens of scoured wool by T. F. Nettleton, wool-scourer, Kaiapoi, Canterbury: splendidly got up, and not surpassed in the Exhibition. Fleece of combing wool, from sheep bred by Mr. J. Hepburn, Goodwood: a merited description of combing wool. Fleece of Leicester ram lamb's wool, 7 lbs. in grease: great weight of wool, but not particularly valuable.

1642.—Matthew Holmes, breeder, Awa Moa Run, near Oamaru, exhibits specimens of pure Leicester, Cheviot and merino, and Leicester and merino wools.

No. 1. A beautiful specimen of Leicester ewe's wool; very sound, open, and clear, and exceedingly well got up.

No. 2. Cross-bred Leicester and merino: a superior specimen of a true cross, preserving all the essential points of the two original breeds.

No. 3. Leicester ewe's wool: not equal to No. 1, and inclined to be cotted.

No. 4. A very good specimen of Leicester ewe's wool.

No. 5. Leicester ewe's wool, rather cotted, and of a coarse description.

No. 6. Long in staple, but tender.

1643.—The same exhibitor shows fleeces of Cheviot wool, viz.:—Cheviot ram hogget, 6½ lbs. washed: good sound wool, but badly washed. Cheviot ram's, 8½ lbs. in grease: a fine specimen of Cheviot wool. Cheviot ram, 6½ lbs. in grease: not deserving of mention. Washed Cheviot ram: a good specimen of wool of this breed, but badly washed.

1647.—M. R. Swanston, Waikaia Plains, Mataura, exhibits fleeces of merino wool, cold-water washed, fair specimens of Otago wool.

1648.—J. Hassel, Oamaru, exhibits fleeces from sheep imported by Messrs. Campbell & Low, Benmore, Waitaki, viz.:—

No. 1. One fleece, pure Rambouillet two-tooth ewe, imported, bred by the Emperor of the French, by the best Rambouillet ram, out of a picked ewe.

No. 2. Fleece, Rambouillet ram, two-tooth, of same blood as No. 1.

Southland.

1639.—M'Kellar Bros., Waimea Plains, exhibit skin of merino wool of several years' growth, but owing to the breaks in the staple, its properties are seriously impaired.

1644.—R. Hill, Croydon, Hokanui, exhibits six fleeces of merino wool, of pure breed, and showing all the desirable qualities of merino wool.

New South Wales.

1611.—William Krammie exhibits a case of samples of merino wool from the stud flocks of R. J. Traill, Esq., of Calleroy, New South Wales.

Tasmania.

1612.—James Stewart exhibits a fleece of merino wool, washed, weight of fleece 4½lbs. Exhibitor states that the average price of this wool in London, in 1864, was 2s. per lb.

1613.—R. & D. Flexmore, Green Ponds, show a case of fleece washed wool.

1614.—Charles Headlam—A fleece of Saxony merino ram's wool; weight of fleece, unwashed, 11½lbs., eleven months' growth.

1666.—P. F. Smith shows a case of cold water washed merino wool, of great excellence as regards the washing, and of very superior quality.

IMPORTS OF COLONIAL WOOL INTO ENGLAND.—During the first ten months of 1864, *the total imports of Colonial Wool into England amounted to* 391,737 *bales, against* 345,543 *in the corresponding period in* 1863. *Annexed are the particulars :—*

WHERE FROM.	1863. Bales.	1864. Bales.
New South Wales and Queensland...	54,800	69,284
Victoria	94,018	119,362
Tasmania	15,111	8,574
South Australia	36,525	41,387
West Australian...........................	2,233	2,664
New Zealand	32,037	43,968
Cape of Good Hope :		
Algoa Bay and Port Natal	49,968	51,885
Cape Town............................	8,056	9,056
East Indies.................................	52,795	45,567

The following figures show the Increase and Decrease in the Importations of 1864 compared with those of the previous Season:—

	INCREASE. Bales.	DECREASE. Bales.
New South Wales & Queensland......	14,484	......
Victoria..................................	25,354	......
Tasmania................................	......	6,537
South Australia.........................	4,862	......
West Australia..........................	431	......
New Zealand.............................	11,931	......
Cape of Good Hope:		
Algoa Bay and Port Natal.......	1,917	......
Cape Town..........................	1,000	......
West Indies..............................	......	7,238
Totals..............................	59,969	13,775

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

1601. F. D. RICH, Otago.—General superiority of Merino Wool.

1609. JOHN GRIGG, Auckland.—General superiority of Leicester Wool.

1643. MATTHEW HOLMES, Otago.—Superior cross-bred Leicester and Merino Wool.

1636. SMITH & CO., Tokomairiro.—Superiority in Wool scouring.

1666. P. F. SMITH, Tasmania.—Very superior washed Merino Wool.

CLASS IV.

SUB-CLASS B.—OTHER ANIMAL SUBSTANCES USED IN MANUFACTURES.

SECTION II.—RAW SILK AND GLUE.

JURORS.

J. A. EWEN. | J. BUTTERWORTH.
T. C. SKINNER.

SILK.

EXCEPTING as an interesting experiment, the production of Silk has not been prosecuted in the Australasian Colonies. The results of these experiments have, however, been so far successful as to encourage the belief that the pursuit can be made profitable. There are no reasons why the silk-worm should not be thoroughly acclimatised in any of the Colonies of the Australasian group, as the climate is in every way favorable, and the requisite conditions for the growth of the mulberry tree, and other plants and shrubs on which the silk-worm feeds, are not wanting.

Silk is the secretion of the worm of silk-moths (chiefly of *Bombyx Mori),* the favorite food of which is the leaves of various species of the mulberry tree. The silk is secreted from a pair of long tubes ending in a pore of the under lip of the worm. Each thread is made up of two filaments coming from these, and they are glued together by a secretion from a small gland. The silk-worm begins to spin when it is full grown, choosing some object on which to attach its first thread, which is drawn from one place to the other until the body of the worm is loosely covered by it. Then the worm connects the threads by moving its head and spinning in a zig-zag way. The cocoon takes about five days for completion, during which the silk-worm lessens its size, then casts its skin, becomes torpid, and takes the form of the chrysalis. The chrysalis of the cocoon is killed by exposing the cocoon to the hot air of heated ovens or

steam; the cocoons are then thrown into boilers or kettles filled with warm water. In reeling or unwinding the silk from the cocoon, the threads of three, four, five, or more cocoons are united to form one thread; —the product is called *raw silk.*

From 250 to 430 cocoons go to the pound. To compose an ounce of eggs of the largest breed of silk-worms of 4 casts, it would require 37,440; if each of these eggs produced a worm, and they all lived, from one ounce of eggs 373 lbs. of cocoons would be obtained. One ounce of worms consume in the—

1st age,	...	6	lbs. of leaves;
2nd „	...	18	„ „
3rd „	...	60	„ „
4th „	...	180	„ „
5th „	...	1,098	„ „
Total,	...	1,362	lbs. of leaves from the hatching

to the formation of the cocoon. A cocoon yields 1,760 feet of spun silk; the ounce of this spun silk is 264,000 feet long. On an average, the silk-worm, in forming its cocoon, draws a thread of half a mile in length. The full grown worm is three inches long.

There are two species of mulberry, more particularly on which the silk-worm feeds—the Black Mulberry (*Morus nigra*), and the white mulberry (*Morus alba*). The *Morus nigra* is the species cultivated in Great Britain, and is the species introduced into the Australasian Colonies. The worms of the South of Europe are fed on the leaves of the White Mulberry, which has the advantage of producing its leaves early enough for the young silk-worms to feed upon, which is not the case with the black mulberry. The silk-worm is sometimes fed on the leaves of other plants, such as lettuce, but the silk in that case is much inferior.

The following is a list of the exhibits of raw silk:—

26.—Mrs. Eric Craig, Auckland: Three skeins of reeled silk, pale yellow; rather uneven in color, but of average quality and fineness.—No statement as to what the worms were fed on.

169.—Miss M. Gledhill, Taranaki, exhibits a sample of raw silk, the produce of 80 worms. The silk is a bright, even yellow, and of beautiful quality, and extreme fineness.

170.—Mrs. James Yems, Taranaki, sends some interesting specimens of silk, silk-worms, eggs, and cocoons. The silk is a bright yellow, fine, and very well reeled.

2818.—Mrs. E. Shoobridge, New Norfolk, Tasmania, exhibits 5½ ozs. of raw silk from worms fed on the black mulberry.

2950.—Lady Dorothy Neville, Dangstin, near Petersfield, Hants., exhibits cocoons of the Ailanthus silk-worm, (*Bombyx Cynthia*) a species of silk-worm cultivated in India, and much esteemed.

2604.—Mrs. Whitaker, Dunedin, sends some fine samples of silk, produced in Victoria.

The whole of the exhibitors in this Sub-Class were considered worthy of the Honorary Certificate.

GLUE.

The utilisation of waste matters is a subject of great importance, and to which too little attention is paid by the inhabitants of colonial towns and cities. There is an immense variety of substances allowed to be wasted, which are capable of being profitably converted to use in the arts and manufactures. Modern science has pointed out the uses of many substances which were formerly regarded as offal, and thrown away, and the result is, that in England and on the Continent, scarcely anything is entirely wasted. Refuse animal substances are particularly capable of being converted to useful purposes, and the specimens of Glue exhibited by Mr. Beissel, of Dunedin, afford an example of what can be done in this way. The exhibitor states that the glue is made from animal refuse found in and about Dunedin. Mr. Beissel may be regarded as a public benefactor for thus converting what would have otherwise remained with other matters which too often decompose, and produce disease and death.

Glue is the chemical substance, gelatine, in a dry state. The principal substances of which glue is made are the parings of ox and other thick hides; the refuse of the leather-dresser; the tendons and other offal of slaughter houses, and in fact refuse animal matter of almost every kind. The materials are first purified by steeping in lime water, then washed and drained, and boiled in a copper until the liquor arrives at the requisite consistency. It is then drawn off, cooled, and dried by exposure to the atmosphere in cakes spread on nets stretched in a frame for the purpose. Good carpenter's glue should be hard and difficult to break with a hammer, though when broken it should yield suddenly to the force, and present a sharp vitreous fracture. The color whether dark or light, should be bright, and not too dark, and without any tinge of green; the substance should be transparent, and free from foreign particles, and the glue should be capable of absorbing a considerable quantity (from four to seven times at least of its weight) of cold water. Generally

speaking, the amount of water thus absorbed will serve as indicative of the goodness of the glue, provided that the resultant mass is not too friable, and remains clear, and that when it has been melted and allowed to cool, the jelly it forms is clear and firm, and not liable to rapid spontaneous putrefaction.

The glue exhibited by Mr. Beissel combines all the necessary qualities, and is quite equal to the imported article. The Jury felt pleasure in awarding an Honorary Certificate to this exhibitor.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

26. **MRS. E. CRAIG, Auckland.—For Raw Silk grown in New Zealand.**
169. **MISS M. GLEDHILL, Taranaki.—Very fine do do**
170. **MRS. J. YEMS, Taranaki.—Raw Silk do do**
2604. **MRS. E. WHITAKER, Dunedin.—Raw Silk, produce of Victoria.**
2818. **MRS. E. SHOOBRIDGE, New Norfolk.—Raw Silk, produce of Tasmania.**
2950. **LADY DOROTHY NEVILLE, England.—Specimens of Raw Silk of Ailanthus worm.**
535. **G. BEISSEL, Dunedin.—Glue from waste animal substances.**

CLASS IV.

SUB-CLASS C. — VEGETABLE SUBSTANCES USED IN MANUFACTURES.

SECTION I.—FIBROUS SUBSTANCES AND MANUFACTURES.

JURORS.

J. A. EWEN. | J. BUTTERWORTH.
T. C. SKINNER.

THE importance of this Class, and the numerous substances it embraces, justify its sub-division under the various heads of—

1. Fibrous Substances and Manufactures.
2. Woods.
3. Vegetable Exudations, and Manufactures therefrom.
4. Dyeing and Tanning Materials.

1. *Fibrous Substances.*—Under this head, prominence must be given to the native Flax, or *Phormium tenax,* as it is at once the most important and valuable fibrous plant indigenous to the Colony, and has attracted the greatest amount of attention.

From the earliest period of European settlement in New Zealand, the value of the native flax has been recognised, and it has always been regarded as one of the most important natural productions of the Colony. The desirability of opening up a profitable export trade in the prepared fibre led to numerous attempts on the part of the settlers to discover a method of preparing the fibre by a process less laborious and wasteful than that adopted by the Maoris. The Government of the Colony, impressed with the importance of the subject, voted a large bonus for the production of 100 tons of fibre of mercantile value which should leave a profit on the process. From a variety of causes, the numerous experi-

ments which have been made do not appear to have been attended with complete success, and the Government reward still remains unclaimed.

The first European who drew attention to the value of the *Phormium tenax* was the great navigator Captain Cook, who spoke of it as something superior to either flax or hemp. To the natives, this plant was almost as valuable and necessary as the cocoa palm is to the savages of the South Sea Islands, or as the bamboo is to the Chinese. With the leaves, cut into strips, they bound together the framework of their houses, and the defensive palisading of their pahs. Clothing, baskets, fishing nets and lines, and sails for their canoes were manufactured from the fibre; whilst from the seeds and roots of the plant they extracted useful medicines.

As the islands became better known to Europeans, and trade was opened up with the native tribes, the prepared fibre formed an important article of exchange. Specimens of it had been forwarded to England, where they created much interest, and it was regarded as an article the excellence and abundance of which might possibly render the British manufacturers independent of the supply from Russia. A regular trade soon sprang into existence, the natives gladly exchanging the prepared fibre for European commodities. So profitable did the Maories find this branch of industry that they employed large numbers of their women and slaves in the cleaning of flax, and there was hardly a single village in flax-growing districts in which the manufacture of flax was not carried on.

In 1828 there was imported into Sydney from New Zealand, for shipment to England, 60 tons of prepared fibre, averaging in value £20 per ton, or £1,200. In 1830 the quantity increased to 840 tons, worth at the same estimate £16,800; whilst in 1831 it reached to 1,062 tons, worth £21,240.* M'Culloch states that the exportation of New Zealand flax to Van Diemen's Land and Sydney in 1831 was only 786 tons, but it is quite evident that a large quantity was shipped at this period, as may be estimated from the tonnage of shipping chiefly engaged in the trade.

In 1830, says Mr. Murray, twenty-eight vessels, averaging 110 tons each, made fifty-six voyages to New Zealand from the adjoining Colonies; and in the same year, twenty-six vessels, of an aggregate capacity of 4,959 tons, sailed from New Zealand to England. Most of these vessels were chiefly engaged in the flax trade. The figures just quoted must appear strange to those who are aware of the languishing condition of the trade at the present time. The following statistics, taken from official

* John Murray, F.S.A., F.L.S., on the *Phormium tenax*.

records, show how gradually the export of New Zealand flax has fallen off, until it is now scarcely worthy of mention in the Trade Returns of the Colony :—

EXPORTS OF FLAX.

		Value.	
1853	£2020	1	9
1854	2240	0	0
1855	5519	17	8
1856	1571	5	0
1857	690	0	0
1858	1516	0	0
1859	2405	0	0
1860	1240	0	0
1861	48	0	0
1862	261	0	0
1863	251	0	0
1864	162	0	0

Before proceeding to notice the results of the various efforts which have been made to revive the flax manufacture in New Zealand, a description of the plant itself will not be out of place.

The *Phormium tenax* belongs to the natural order *Liliaceæ*, is indigenous to New Zealand, and grows more or less abundantly throughout the islands. Its generic name is derived from the Greek word "Phormos," *a basket* (the latter being one of the many purposes to which it is applied by the Maories), and its specific appellation has reference to its tenacity or strength. There are two, if not more, distinct varieties, differing from each other in the color of their flowers, the one being red and the other yellow. The plant has a flag-like appearance, the leaves springing from the root in ribbon-like bands to the height of from five to ten and twelve feet. It bears large tubular flowers, on a stalk about nine feet in length, flowering once in three years. The plant itself is perennial, and the leaves attain their full length the third year of their growth, that period being generally marked by their splitting at the end. The roots are purgative, diuretic, sudorific, and expectorant.

The *Phormium tenax* grows on almost any kind of soil. It may be found on the dry slopes of hills and in the midst of swamps. It flourishes best, however, in alluvial soil, in low marshy situations. That variety of the plant which grows in the South part of the Colony is said to yield the finest description of fibre. According to the natives, there are ten different varieties, but Dr. Thompson says that eight of these are merely alterations produced by variations of soil and culture. He also states that the fibre obtained from the yellow-flowered plant is finer and more valuable than that from the red. The fibres lie longitudinally in the leaf, being surrounded by a cuticle or epidermis of a glutinous and chlorophyc

character; and it is this which presents the greatest obstacle in the cleaning of the fibre.

The fibres are exceedingly strong, an illustration of which is afforded by the following comparative table:—

The fibre of the	Agave Americana	will bear a strain of	7 lbs.
	Common Flax ...		$11\frac{3}{4}$
	Russian Hemp...		$16\frac{3}{4}$
	Phormium tenax.		$23\frac{7}{16}$
	Silk................		34

Professor Lindley gives the comparative strength of fibres as follows:—

Silk	34
Phormium tenax	23
European Hemp	16
European Flax	11

It will thus be seen that the fibre of the *Phormium tenax* is somewhat weaker than silk; more than double the strength of ordinary flax, and considerably stronger than Russian hemp.

As prepared by the natives, about four to four and a half tons of green leaves will produce a ton of fibre. According to Salisbury, a plant about three years old will produce on an average 36 leaves, besides offsets from the roots, and it takes about six leaves to yield one ounce weight of fibre. At this estimate, an acre of ground planted three feet apart would yield about 16 cwt. of fibre. But the plant improves much by cultivation, growing more rapidly and luxuriantly, and yielding a better description of fibre. When cultivated, as much as $2\frac{1}{2}$ tons per acre has been yielded. In Russia, $1\frac{1}{2}$ tons of hemp to five acres is considered a fair crop—worth say £45; whilst at a low estimate, five acres of ground would produce four tons of New Zealand flax—worth say, at £20 per ton, £80.

The value of the *Phormium tenax* is increased by the circumstance that, being perennial, neither ploughing nor sowing are required to be repeated. The natives used formerly to cultivate the plant for the fine fibre used in the manufacture of the best kind of mantles and fishing lines. Mr. Wakefield, in his "*Adventures in New Zealand from* 1839 *to* 1844," speaks of observing extensive flax cultivations on the table-lands above Ikurangi, in the North Island; the plants were all of the kind called *tihore* or best, having leaves 10 to 12 feet in length. They were planted in a rich loamy soil, and grew so luxuriantly that although set

eight feet apart, the outer leaves of the plants touched each other. In the majority of cases the natives selected a rich alluvial soil, in a low situation and covered with fern; the fern was burned off and the seeds scattered in the ashes.

The native method of preparation was a tedious and wasteful operation, fully one-half of the fibre being cast aside; and is altogether unfit for adoption by those to whom time and labor are valuable considerations. The leaves were gathered and taken to the place of manufacture in the green state. With the sharp edge of a mussel or other shell, an incision was made transversely across the leaf and just dividing the outer skin, which was then stripped off and thrown away. The remaining portion was then scraped until the inside cuticle was separated from the fibre, the process being completed by repeated washings and exposure to the sun. Sometimes the leaves were first macerated in water and then scraped. These processes, although slow and improvident, were at least effectual, and the fibre produced was sound and clean. For special purposes the finest fibres were selected, and this highly finished flax was of a beautiful white color, and strong and glossy as silk. As the natives began to adopt European clothing, the manufacture of flax mantles, &c., gradually decayed, and the trade in flax likewise fell off, until it is now only preserved in a few localities. The finer kinds of mantles are now very rare, and fetch high prices amongst the natives themselves.

Numerous attempts have been made by the colonists to convert the *Phormium tenax* into a source of national wealth, and the subject has also at various times engaged attention in Great Britain, and Companies have been formed for the purpose of carrying out the manufacture. In 1831 a manufactory was established at Grimsby in Lincolnshire for the production of articles made from New Zealand flax, and according to the testimony of contemporary authorities, the results were not considered unsatisfactory. From some unexplained cause, however, the undertaking did not long survive. Other efforts have been made for working the fibre in England on a large scale, but owing to the irregularity of the supply, and other causes, they appear to have been abandoned at an early stage. In most of these speculations, the operators relied on artificial chemical agents for dissolving the glutinous epidermis of the fibre, and it is well to note that alkalies or acids invariably deteriorate the strength of the fibre, and for this reason their use should be discouraged.* Not much greater success appears to have rewarded colonial enterprise in this branch of

* Vide Appendix A., Art.: Fibrous Substances.—ED.

industry. Thousands of pounds have been spent in fruitless experiments, and machinery of all kinds has been invented and constructed with no better result.

As far as the simple production of a good clean fibre is concerned, some of the attempts have been quite successful, but it has unfortunately happened that the cost of production has left no margin of profit on the sale of the article. There are many reasons to account for the difficulty experienced in establishing the flax manufacture in New Zealand. In the first place, the rapid spread of colonisation, and the alienation of the waste lands of the Crown to private proprietors, has very much narrowed the source of supply of wild flax, which for the most part grows most luxuriantly on soil that is selected by the settlers for agricultural purposes. In the event of a thoroughly effective and economical plan of preparing the fibre being discovered, cultivation of the plant would have to be resorted to, as the stock of wild flax is not only becoming scarcer, but would each year be getting at a further distance from the place of manufacture and shipment. The cost of conveying the raw material from any considerable distance is a great obstacle to the business, and amounts almost to a prohibition. The great questions for solution are—first, Can a marketable fibre be produced at a sufficiently cheap rate? and second, Will it pay to cultivate the plant?

It cannot be said that the solution of the first question was afforded by any of the specimens displayed in the Exhibition. One exhibitor (125), showed a beautiful fibre, which, according to his own statement, cost more money than its market value in London; whilst the only other exhibitor who gave any information as to the cost of production exhibited only a rough, coarsely prepared sample. It is to be regretted that the other exhibitors omitted all mention of information concerning price, and thus considerably lessened the practical utility of their exhibits. It cannot be said, judging from the character of the specimens exhibited, that much improvement has been made in the preparation of the fibre; although it must be admitted that much better samples could have been shown, if the Auckland flax cleaners had exhibited.

Past experience leads to the opinion, that although unquestionably the fibre of the *Phormium tenax* is capable of application to the finest purposes of textile manufacture, it cannot compare practically with the ordinary flax of Europe, and that all attempts to produce an article to compete with European flax will only result in disappointment. The most profitable and attainable object appears to be the production of fibre

sufficiently clean and fine for the coarser branches of manufacture, and which shall be accomplished at a minimum expenditure of labour. For a great variety of articles, in the manufacture of which coarse kinds of flax and hemp are employed, the fibre of the *Phormium tenax* is eminently adapted. The demand in Britain for such a fibre is practically unlimited, and there is not the slightest doubt that if the British manufacturers could only depend on a supply, sufficiently extensive and regular, to make it worth their while to adapt their machinery to it, the New Zealand flax so prepared would be largely employed.

The New Zealand flax makes excellent rope, although it does not absorb tar freely. A medal was awarded at the Great Exhibition of 1862 to Mr. Lloyd, of Auckland, for a rope manufactured by him. Formerly a flourishing rope factory existed in Auckland, but, owing to the inadequate supply of material caused by the native rebellion, it is now at a stand still. The absence of any samples of flax from Auckland is to be regretted, the more so as in that Province more attention has been given to the subject of flax manufacture than in any other part of the Colony. Messrs. Purchas and Ninnis, of Auckland, have patented a machine for cleaning the leaves in their green state. The principle of their invention is beating the leaves with small iron fallers or hammers, a stream of water flowing continuously over the leaves during the operation, and thus washing away the extraneous particles and the glutinous matters as they are loosened and expressed by the hammers. This machine has the advantage of being portable, and can thus be carried about the country to the flax-growing localities, and worked close to the raw material. It is stated to have proved very successful, but the outbreak of the Waikato war, in 1863, compelled the patentees to suspend operations. The patentees exhibited specimens of the fibre dressed by this machine in the Great Exhibition, 1862, for which they received a medal.

Very excellent twine, made from New Zealand flax, is exhibited by Mr. Scott, of Invercargill. The application of this fibre to the manufacture of paper is illustrated by specimens of paper exhibited by Mr. W. Colenso, of Napier. This paper, which is excessively tough, was manufactured in England, and it was employed very appropriately for the work by John Murray, F.S.A., F.L.S., on the *Phormium tenax*, extracts from which have been made in this report. It is interesting to notice that an attempt is being made to establish a paper manufactory in Christchurch, the projector of which, Mr. R. Cameron, exhibits specimens of prepared pulp, in various stages of manufacture. These specimens appear fully to

justify the sanguine expectations of the introducer of this new branch of local manufacture.

That the *Phormium tenax* will yet become an important source of national wealth, no one who believes in the powers of inventive genius and mechanical skill can doubt. It only remains to be proved whether it will be profitable to cultivate the plant—a problem which has not yet been satisfactorily solved.

The following is a list of the exhibits of *Phormium tenax* in various stages of preparation :—

Hawke's Bay.

125.—W. Routledge—Two specimens of "scraped" flax, prepared by Mr. Attwood, Wairoa, the cost of which is stated to be £48 per ton. These samples are exceedingly good, the fibre being very clean and white and of great length. It is to be noticed that the fibres are fine and unbroken, and retain that glossiness of surface which obtains in the higher qualities of European flax. There appears to be some trace of chemical agency in the preparation of these samples, but the strength of the fibre has been well preserved. Accompanying these samples is the copy of a letter from Messrs. G. & J. A. Noble, Brokers, of George Street, Lombard Street, London, estimating the value of the fibre at from £40 to £42 per ton. At this valuation the article clearly will not yield a profit, and this affords another reason to justify the opinion already expressed, that it will not pay to export highly dressed flax.

Mr. J. A. Smith, of Napier (Catalogue page 156), exhibits a case containing a variety of specimens, illustrative of the application of the New Zealand flax to various branches of manufacture. Samples are shown of "half-dressed" flax prepared by natives, and valued at £10 per ton in London : Auckland dressed flax, clean but not fine, worth £20 per ton ; fine dressed fibre worth £40 per ton ; and some very fine worth £70 per ton. The last mentioned sample is as fine as the finest Belgian flax, and capable of being spun and manufactured into very fine fabrics. This is proved by a sample of beautifully fine cambric, which rivals in its appearance the choicest productions of the looms of France. Samples are also exhibited of stout canvas for steam-boats, and of sail cloth of various qualities, as well as white twilled stuff for cavalry trousers. A specimen of sewing thread is also shown, which equals the best thread used ordinarily by tailors.

It is impossible, after an inspection of the various specimens exhibited in this case, to doubt the applicability of the fibre of the *Phormium tenax*

to the various purposes of the British manufacturer; and the evidence thus afforded should serve as a great inducement to perseverance in the development of the valuable national resource which the native flax supplies.

Wellington.

248-262.—William Davies, Otaki, exhibits a very interesting series of specimens of fibre in the various stages of its preparation by the Maoris for the manufacture of rope and mats. There is a noticeable feature in the fibre prepared by the Maoris, and that is its softness and pliable nature. The flax prepared by Europeans, whether from some peculiarity in the process or the want of sufficiently careful selection of the raw material, possesses a harshness to the touch which does not obtain in the case of fibre produced by the natives. Probably the use of alkalies, which is more or less practised by Europeans, may have some influence in causing the harshness referred to. The flax in the collection under notice, which is intended for ropemaking, is admirably adapted for the purpose; as are also the other samples prepared for sewing and embroidering the mantles worn by the natives. In preparing the leaf of the *Phormium tenax* for the different kinds of mantles, the natives very ingeniously take advantage of natural peculiarities. One kind of mantle is shaggy, the leaf being divided into very thin strips which are allowed to retain the glutinous skin, which imparts the desired shagginess, the strips hanging in thick tufts about 10 inches long from the woven portion of the fabric—resembling much the thatch of an English cottage. Another description of mantle presents the appearance of a mass of pendant serrated quills,—an effect produced by scraping the leaf when green at intervals of about an inch, leaving the skin on the intermediate spaces. As the leaf of the flax plant when dry curls into a tubular form, the uncleaned spaces assume quill-like shapes, and give the peculiar appearance already referred to. The yarn used by the Maoris for weaving the inside of their mantles consists of loosely-twisted threads of fine selected flax, of which beautiful specimens are exhibited.

Excellent samples of small rope and clothes lines are exhibited by Mr. William Davies, Otaki.

246.—Mr. W. L. Buller, Manawatu, exhibits a very interesting collection of specimens of native prepared flax, used in the manufacture of mantles. He also exhibits a sample of fibre prepared from the Kie-kie plant (*Freycinetia Banksii*), and specimens are shown of native dyed threads made from the *Phormium tenax* and stained in decoctions of

various barks. The color produced by the bark of the Toatoa (*Phillocladus trichomanoides*) is a beautiful brown. The "Hinau" dyed black is very brilliant.

The flax fibre is extensively used for stuffing mattresses, and a sample of curled fibre for seating, &c., is exhibited by Mr. C. W. Hornblower. A specimen is shown, stated to have been taken from a bed that had been in constant use for ten years, and which still preserves its elasticity.

Nelson.

315.—Excellently prepared samples of dressed flax are exhibited by Mr. J. Thompson. The fibre is well cleaned and strong.

316.—Mr. T. W. Tatton exhibits several specimens of chemically prepared fibre, which although fine are deteriorated in strength and quality. The same exhibitor shows samples of fibre, illustrating the readiness with which it absorbs the most brilliant dyes.

Canterbury.

445*c*.—Mr. Robert Cameron, Christchurch, exhibits an interesting case of samples of fibre as prepared for the manufacture of paper. They are in the condition of "half stuff," and clearly show the adaptability of the native flax for the manufacture of paper.

Otago.

539.—Mr. James Forsyth, Tokomairiro, shows specimens of prepared fibre, which do not call for further mention.

540.—Mr. Honeyman, Water of Leith, Dunedin, exhibits a quantity of prepared fibre for rope, twine, and other coarse purposes, for which it appears well adapted. Flax similarly prepared would command a ready market in Britain, and would be suitable for spinning by machinery into coarse and medium yarns. The process adopted by this exhibitor is as follows:—The leaves are passed between fluted iron rollers under a heavy pressure, which bruises the outer skin; they are afterwards steeped in water and allowed to ferment for several days, until the gum becomes dissolved. The leaves are then squeezed through smooth iron rollers, which express the glutinous matter, and are afterwards steeped for several hours in a weak alkaline ley, then washed in clean water and finally dried, when the fibre is ready for the hackler.

Mr. Honeyman has, also, tried with success the process of stamping or beating the leaves by means of iron-shod "stamps," worked with revolving cams. The leaf is drawn gradually forward by a pair of holding rollers in front of the beaters, three or four leaves being passed under each stamper at a time. The produce of fibre in the processes described is in

the proportion of about one ton to four tons of green leaves, exclusive of waste fibre and other refuse, which would be valuable to paper makers.

543.—Very fair samples of roughly prepared fibre are exhibited by Mr. Robert C. Parker, George Street, Dunedin, which the exhibitor states can be supplied at the rate of £18 per ton, at which price it ought to yield a profit on export.

Southland.

1211.—Mr. J. Scott, Invercargill, exhibits some excellent samples of twine manufactured from New Zealand flax. A sample of prepared fibre also reflects great credit on the exhibitor.

Tasmania.

2819.—Mrs. Johnston, Glenorchy, shows a case of samples of prepared fibre of the *Phormium tenax*, grown in Tasmania, and prepared, says the exhibitor, "by a simple process applicable by machinery, or as a domestic employment, by which the exhibitor estimates that a woman could dress half a ton per week." The *Phormium tenax* grows well in Tasmania, but not so luxuriantly as in New Zealand. The samples under notice are inferior to the other exhibits under this head.

2820.—Mr. R. Backhouse, Hobart Town, exhibits a specimen of the wild *Linum* of Tasmania. The stem is about 30 inches long, and resembles generally the cultivated European variety. The same exhibitor also sends a sample of flax grown from English seed, which appears to be quite equal to the home grown flax.

Although there are no exhibits from the New Zealand Provinces of true flax (*Linum usitatissimum*), a specimen is exhibited by Mr. Smith of Napier, Hawke's Bay, which he terms *Linum perenne**, and which, according to the statement of the exhibitor, grows wild in that part of the colony. The small sample of the roughly-scutched fibre shown with the plant appears to resemble the lower descriptions of Baltic flax.

The climate of New Zealand and Tasmania is very favorable to the cultivation of flax, a branch of agricultural industry which will probably in future years be profitably followed. Flax grows best in climates of equable temperatures, and accommodates itself to a great variety of soils.

The improved plan of retting flax invented by Mr. Schenck of New York, and which has effected quite a revolution in the preparation of flax, appears so well adapted for the New Zealand flax that a short description of it may be appropriately given in this report. It is thus described in

* ? *L. monogynum*, Hook, fils.—ED.

"*Newton's London Journal and Repertory of Arts, &c.*," for August 1851:—

"The principal apartment in the building (near Belfast) contains a number of large circular vats in which the flax is steeped, and these are provided with steam-pipes connected with the engine boiler. The flax to be operated upon is placed in the vats, and filled up to a given height; strong cross-bars of wood, forming a kind of framework, are then laid above the flax and secured to the vats, the object of this being to keep the flax down in the vat, as otherwise it would rise as it swelled in fermenting, and protrude above the water. When a mass of flax is thus secured, water is run into the vat, and as it becomes absorbed, more is added. Steam is next admitted into and made to circulate through the steam pipe at the bottom of the vat, so as to raise the water to about 90° Fahr. and maintain it at that temperature. In a few hours, acetous fermentation is established in the vat, and the decomposition of the resinous or gummy matter in the stalks proceeds with rapidity. After about 60 hours, the decomposition is completed, and that without the exudation of any odorous or noxious effluvium. The water, surcharged with the mucilage, is then drawn off, the framing is removed, and the flax is taken out of the vat to be dried, either in the open air or by artificial means."

The above-mentioned process is so exceedingly simple, and easy of application where steam is accessible, that it is evidently well worthy of attention.

Of paper-making materials the Exhibition contains a considerable variety, chiefly comprised in the very interesting and valuable collection presented by Dr. Lindsay, and in the Indian Collection. New Zealand, however, produces a number of fibrous plants and grasses suitable for the manufacture of paper, a branch of industry which must at some future time become an important one in this colony. The bountiful supply of pure water with which almost every portion of the colony is blessed, and the facilities which exist for the erection of mills to be driven by water power, combined with the abundance of paper-making material which grows in profusion throughout the colony, constitute New Zealand as *par excellence* a favorable country for the production of paper for the supply of this and the other Australasian Colonies. With regard to paper-making material the *Phormium tenax* must again occupy the first place. Not only is the fibre itself admirably suited to the purpose, but it is the more valuable inasmuch as the refuse particles of fibre after its preparation for spinning purposes are available for the manufacture of paper. In the

event of the cultivation of the *Phormium tenax* there will always be a large quantity of damaged and what would othewise be waste leaves, which would be valuable to the paper maker. There are several samples of paper in the Exhibition made from this fibre. In the Hawke's Bay Collection, Mr. Colenso exhibits a specimen of the paper made from *Phormium tenax*, prior to 1838, and the work already referred to, by Mr. John Murray, is printed on paper of this description. The peculiarity of this paper is its tenacity, which property should make it valuable for documents and printings intended to stand a great deal of wear and tear. No better paper could be used for bank notes, or for the printing of valuable standard works.

Many of the native grasses of New Zealand are sufficiently fibrous for the manufacture of paper, and the profusion in which they grow on almost every variety of soil, and under every condition of the climate, is an additional reason why efforts should be made to utilise them. One variety of grass in particular claims attention from its resemblance in many important features, to the Esparto or Spanish grass, an article which is now very extensively used in the manufacture of paper in England; this is the "snow grass," one of the tussocky grasses of the colonists, *Schœnus pauciflorus (Hook fils)*, which grows rank and luxuriant at high elevations and on barren soil in the interior of the Middle Island. Experiments have already been made by an enterprising colonist, Mr. Edward McGlashan, of Dunedin, as to the paper-making qualities of this grass, and the trial was sufficiently satisfactory to establish its value for the purpose. A want of suitable machinery has prevented any trial on a large scale, and there is as yet hardly sufficient inducement to do so. From the general resemblance of this grass to the Esparto, an account of the uses and mode of conversion of the latter will be interesting. We condense the following description from the Jurors' Reports, International Exhibition, 1862:—Esparto or Spanish grass called "alfa" by the Arabs, is indigenous in the mountains and uncultivated districts on the Mediterranean Coast, and on the north coast of Africa. It is classed as a sedge by botanists *(Spartium seggarem* and *Stipa truncissima)* and grows in tufts and branches similar to the rushes in England. It varies in length from two to four feet, and consists of a long flat leaf, which, as the sap descends and the plant ripens, takes a cylindrical form. It is pulled up from the roots, exposed to the sun, and when dry, laid in small bundles for conveyance to the port of shipment. The enormous consumption of this grass in England for various manufacturing purposes, but chiefly for

paper, may be estimated from the fact that it is imported to the extent of from 10,000 to 12,000 tons yearly. At one time the price was as high as £5 per ton, but latterly the value has decreased owing to the depression in the paper trade. The Esparto was first brought into practical use by Mr. Thomas Routledge, of Eynsham Mills, Oxford, and the following notice of his patent is given in the Report already referred to :—"The process employed by Mr. Routledge would appear from the increasing use of this material, to be the most useful, effectual, and economical. Mr. Routledge represents, indeed, that the cost of production either in the condition of half-stuff or paper is below that of rags to produce a similar quality of paper, and the power required for reduction much less. * * * "One satisfactory feature in Mr. Routledge's process is the fact that no material alterations in existing machinery or appliances are required; no higher pressure boiling in expensive vessels is necessitated; the silica, always more or less combined with a coating of raw fibres is got rid of, and the gummo-resinous matter neutralized, permitting the fibres to be eliminated and drawn out by the ordinary pulping engine as now practised with rags. The assurance of a successful result appears to be dependent on the proper adjustments of the proportions of the chemicals employed; this secured, and the process is extremely simple." The fibres produced from the Esparto are lighter than those from any other paper-making material, and their mechanical structure admits of minute sub-division without destroying the feathery or mossy arrangement which facilitates the intimate felting or blending of the fibres on the endless wire of the paper machine. Paper made from Esparto takes a finer surface than that from cotton rags, and feels thicker in the hand. It is largely employed in the manufacture of printing papers. A specimen of Esparto is included in the collection of paper-making materials contributed by Dr. Lauder Lindsay, and samples of the paper made from it are shown in the same collection.

The Cabbage-tree of the colonists (called *Ti* by the natives) *Cordyline australis*, is another valuable fibrous tree, the whole tree being fibrous, and could be made into paper. It grows to a diameter of from one to three feet, and a height of from 10 to 20 feet, and is found chiefly in swampy situations, although it grows also on hill sides. The stem is thickly fibrous, and the leaves, which are long, ribbon-like, and about two and a half inches broad, contain a good deal of fibre.

The leaves of the Nikau, a species of palm which grows in the Northern portion of the North Island, also yield a strong fibre.

Many varieties of grasses in the genera *Triticum*, *Agrastis*, *Arundso*, and *Danthonia* could be used for paper-making.

In the botanical collection of the Otago Museum, case K (758), is a specimen of the inner bark of the Lace tree (*Plagianthus Lyallii*), from the West Coast of Otago. This is a shrub tree, the bark thick and fibrous. The wood is also fibrous, and could be converted into paper.

The inner bark of the Ribbon tree (*Hoheria populnea*), a specimen of which is exhibited by Dr. Richardson (759), is fibrous.

Another variety of Ribbonwood (*Plagianthus betulinus*), yields a thick fibrous bark suitable for paper-making, but no quantity of it could be procured. A specimen of this bark is exhibited in case L.

There is a curious plant, yielding a cotton-like floss, which grows in poor clay soil in the North Island. It is a species of *Astelia*, and is called Kaha Kaha by the Maoris. The leaves are closely packed in a bulbous form near the root, spreading outwards at the distance of about six inches. The leaves in the bulbous portion are thickly coated with a silky down, about ½ to ¾ of an inch in length, and of a bright glossy appearance. When stripped off the leaves, this down much resembles floss silk. As much as ten per cent. of this down has been taken off the plant. Specimens of the plant, flower stem (two feet long), and of the gathered down are exhibited by Mr. T. B. Gillies (761). At present this material is only used as a substitute for feathers for pillows, &c., to which it is said to be quite equal. It would, however, doubtless form a useful paper material.

Similar to the Kaha Kaha is the Cotton grass of the colonists (*Celmisia coriacea*), of which several specimens are exhibited.

The fibre of the trunk of the *Cordyline indivisa*, a West Coast tree, is used by the Maoris in the manufacture of mats, and could be applied to the purposes of the paper-maker.

The Kie-kie (*Freycinetia Banksii*), which grows in the North Island, is a valuable fibrous plant, and is used by the Maoris for various purposes.

The case of specimens contributed by Dr. Lauder Lindsay to the Otago Museum, is valuable and interesting as illustrative of the great variety of vegetable fibres that can be used for paper or textile manufactures. An examination of the contents at once dissipates all doubt of the ultimate utilisation of the various indigenous fibrous plants of New Zealand, for when it is seen how many apparently unlikely materials, by means of scientific and mechanical skill, can be converted into useful and valuable substances, the conviction arises that by the same means many

hitherto considered useless natural products of this Colony may similarly be turned to profitable account. The "Fibre Series" of this collection is divided into two sections, viz. :—Fibres of British plants, and those of plants, shrubs, or trees abundant in the East and West Indies and other British possessions. The British plants producing fibre, of which specimens are placed in this collection, are—Hollyhock, Marsh Mallow, Jerusalem Artichoke, Horse Radish, Nettle, Lime tree, Elm bark, Scotch Fir, Sweet Pea, garden Crocus, garden Verbena, Hopbine. The fibre produced from nearly all the plants above mentioned is suitable for the purposes of the manufacturer. Some, indeed, of the samples are surprisingly good, and closely resemble the common flax, a comparison with which can be made by a specimen of flax included in the collection.

The series of fibres produced from foreign plants includes fibre of the American Aloe or Agave Americana, Jute, Rheu or Chinese Grass, Mahoe or Bark of Jamaica (*Malvaviscus arboreus*), Manilla Hemp, Neilgherry Nettle, India Pine, and Plantain, all of which are utilised in manufactures.

The paper series is exceedingly interesting. Samples of paper are shown manufactured from almost every variety of material. The interest of this collection is increased by the fact that it includes samples of the paper made in competition for the prize of £1000 offered by the proprietors of the London *Times*. These specimens comprise paper made from the stem of the garden Hollyhock and Brackenfern, each of which has the appearance of a serviceable paper. Samples are shown of paper made from leather cuttings, wood shavings, fern, beetroot refuse, spent tan, hopbine, straw, broom, green clover, common hay, Manilla hemp, gunny bags, American aloe, plantain, bamboo, ice plant, paper mulberry, Esparto or Spanish grass, and flax papers. Many of these come in for a more extended notice in the admirable catalogue of the Indian collection, by Dr. J. Forbes Watson.

COTTON.

Cotton (*Gossypium*), by far the most important product of the plants of the order *Malvaceæ*, is cultivated through a wide range of latitude—from the Line up to 37° North, and down to 30° South. With respect to elevation, cotton extends to nearly 9000 feet above the sea level in Equatorial America; in Mexico to 5000 feet in 19° N.; and in the Himalaya to 4000 feet in 30° N. In the United States the cotton plant is an annual, and must be grown every year from the seed, the plant being regularly destroyed by the winter frosts; but in the milder climates of

Egypt, India, and Australia, it is a perennial, and requires renewal from seed at only long intervals, a circumstance that materially lessens the cost of cultivation. Cotton grows wild in the Fiji Islands, and has likewise been cultivated there with great success, so much so as to warrant the belief that in a few years these islands will produce a large quantity of this valuable staple.

A sample of cotton grown on the island of Ovalan, one of the Fiji group, is exhibited by Mr. Edward King, of Auckland (29), who was also an exhibitor at the International Exhibition in London, 1862. In the Jurors' Report we find that the sample shown by Mr. King was stated to be "equal to middling Orleans;" and the same remark may be attached to Mr. King's exhibit in this Exhibition.

Cotton is not indigenous in any part of the Fiji group, although it has so been commonly believed. It has no doubt existed as a plant in the Fijis for a good many years, and has become naturalised there. Dr. Seeman, whose work on the Fiji Islands is the most recent and reliable authority on the subject, noticed six different kinds, all of which are shrubby, and produce flower and fruit throughout the whole year, though the greater number of pods arrive at maturity during the dry season, from June to September.

There are two kinds of kidney cotton; the one (*Gossypium Peruvianum* Cav.) having naked, the other (*Gossypium sp. nov.*) mossy seeds. A third kind (*Gossypium Barbadense* Linn.) has disconnected naked seeds; a fourth (*Gossypium arboreum* Linn.) has disconnected seeds covered with a greenish moss and long staple; a fifth is probably an inferior variety of the preceding one, and only differs from it in the length of the staple; and a sixth (*Gossypium religiosum* Linn.) being the Nankin cotton, valuable only in certain foreign markets.

Dr. Seeman states that the cotton plants, left to themselves, and never subjected to the pruning-knife, become as high as a tall man can reach, and each shrub spreads over a space of fourteen feet square. He had no opportunity of counting the number of pods produced throughout the year by a single specimen, but that found in July was on the average seven hundred per plant. Twenty pods produced 1 oz. of cleaned cotton, thus making the yield of one plant at one picking 2 lbs. 3 ozs. Allowing fourteen feet square for each plant, an acre would hold 222 plants, yielding at each picking 485 lbs. 8 ozs. of cotton, which at the very low price of sixpence per lb. on the spot, would realise £12. 2s. 9¾d. per acre. Bearing in mind, however, that the pods are continually growing and ripening

throughout the year, at least double the above estimate could be relied upon.

No attempt to cultivate the plant in the Fijis was made until the return of Mr. Pritchard, the British Consul, from England, in 1859, who induced the most influential chiefs to give orders for planting it. His efforts were aided by the missionaries, and the result is that cotton has been thickly spread over all the christianised districts. Mr. Pritchard, before leaving England, pledged himself to his Manchester friends to forward one thousand pounds of cleaned cotton within twelve months, and he experienced no difficulty in obtaining an amount exceeding that promised within the stipulated time. The Manchester Cotton Supply Association furnished Dr. Seemann, on leaving England in 1860, with a large quantity of New Orleans and Sea Island cotton seed, and printed directions for its cultivation. On his arrival in Fiji, Dr. Seemann distributed a fair quantity of the seed amongst the white settlers, and himself established a small cotton plantation in the Island of Tavinui. The New Orleans seed germinated rapidly; sown on the 9th of June the plants began to yield ripe pods within three months, and Dr. Seemann was able to take home a crop from the very seed he had brought out, although his absence from England only amounted to thirteen months altogether. Dr. Brower, United States Vice-Consul, succeeded in raising New Orleans cotton of excellent quality, twelve pods of which yielded 1 oz. of cleaned fibre. The satisfactory results of these experiments led to larger attempts, and now a considerable area of land is under cultivation of cotton.

In May, 1862, the Executive Committee of the Manchester Cotton Supply Association, after an inspection of samples of Fijian cotton submitted by Mr. Pritchard, resolved :—"That these samples are of qualities most desirable for British manufactures; that such a range of excellent cotton is scarcely now received from any cotton-growing country; and that the supply obtained from the United States does not realise nearly so high an average value as this Fijian cotton."

According to a recent letter from the Fijis, published in the *Sydney Morning Herald*, the cotton season of 1864 has proved very successful. The area of cotton already planted, and which will yield in the current year, will be fully double that of last year's crop, and will amount in the aggregate to some five or six hundred acres; whilst the area that will probably be cleared and planted during the year will extend to fully one thousand acres, exclusive of that planted by the natives, which, though consisting of innumerable small patches, is yet hardly to be measured in acres.

It only remains to be added that the soil of the whole Fijian group is eminently adapted to the growth of cotton, and that native labor is abundant and cheap.

Samples of Queensland cotton, comprising specimens of the Sea Island, Egyptian, and New Orleans varieties, are exhibited by Mr. Walter Hill (2705), Director of the Botanical Gardens, Brisbane. This gentleman was also an exhibitor at the International Exhibition in London, 1862, some of his samples being assessed at the high value of 3s. 6d. per lb., and the Jury reported that "the good marketable character of the Queensland cottons is so apparent, that it can only be a question of cost in cultivation and transit; the quality is equal to anything elsewhere produced."

The first person to make the experiment to test the practicability of growing cotton in Queensland was the late Dr. Thompson, Inspector of Government Hospitals in New South Wales. He procured a small quantity of Sea Island cotton seed from America, and forwarded it to the overseer of his station in the Moreton Bay district to be planted. Unfortunately Dr. Thompson died before the result of his experiment was ascertained; but the plants grew vigorously, and the seed they produced was planted by other settlers interested in the subject. In 1847 the first sample of Queensland cotton was submitted by Dr. Lang to the inspection of skilled judges in Manchester and Glasgow, who reported most favorably upon it. Still, beyond establishing the suitability of the soil and climate of Queensland for the growth of cotton, nothing of any moment was done in the matter until 1852, when samples of Queensland cotton were forwarded to the Manchester Chamber of Commerce. In the report made thereon, the samples were estimated to be worth on an average from 17d. to 2s. per lb.; and the opinion of Mr. Thomas Bazley, M.P., the President of the Chamber, was that "such superior and excellent attributes of perfect cotton have been rarely seen in Manchester, and that the samples indisputably prove the capability of Australia to produce most useful and valuable cotton." Since that period, the subject of cotton growing has engaged the earnest attention of the Government and colonists of Queensland, and the cultivation is rapidly extending. The Government, by way of encouraging this branch of agriculture, guaranteed in 1860 a bonus in the shape of land orders to the amount of £10 for each bale of cotton exported during the first three years, and to the value of £5 for each bale exported during the two following years. The American war, and the

stoppage of the cotton supply from that quarter, has given a great impetus to cotton growing in Queensland, and each year shows a large extension of cotton plantations. The following were the results of two experiments in cotton growing, in 1857 and 1858, in the Botanic Garden, Brisbane, by the exhibitor, Mr. Walter Hill, on half an acre of ground, and may be taken as a fair indication of the general adaptability of the soil and climate of Queensland to the growth of this valuable staple. "The seeds were sown in October, in rows four feet apart, and in about six months from the time of planting, the gathering of the fibre commenced, and was continued to the beginning of July. The fibre and seeds of 100 plants were kept separate in gathering during each season, and each plant produced 11 ozs. of seed and 4 ozs. of fibre, yielding at that rate 1871 lbs. 6 ozs. of seed, and 680 lbs. 8 ozs. of fibre to the acre."

The cotton was valued in London at two shillings to two shillings and threepence per lb., showing the value of the crop to be over £68 per acre. The first cost of preparing and sowing the seed does not exceed £5 per acre. One pound of seed will sow an acre of ground. The only obstacle at present to the extensive cultivation of cotton in Queensland is the want of cheap labour; but there is reason to believe that this will be speedily overcome, and that this colony will become one of the great cotton producing countries of the world.

A number of samples of Cotton were exhibited by the Manchester Cotton Supply Association, together with a Gin for separating the seed from the fibre. They were only received shortly before the close of the Exhibition, but were very instructive as examples of the Cotton growths of the various regions in which they were produced.

Cotton has not been cultivated in New Zealand, although doubtless the northern portion of the North Island is suitable to the growth of the plant. A few shrubs are to be found occasionally in the gardens of the settlers as curiosities. The cotton plant assumes the same character in New Zealand as in the Fijis, but does not grow so luxuriantly. It is not likely, however, to assume a position as a cultivated crop.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

315. J. THOMPSON, Nelson.—For prepared Fibre of New Zealand Flax.

445c. R. CAMERON, Christchurch.—New Zealand Flax prepared as "Half-stuff" for Paper.

540. — HONEYMAN, Dunedin.—Well prepared Fibre of N. Z. Flax.

543. R. C. PARKER, Dunedin.—Well prepared Fibre of N. Z. Flax.

2820. R. BACKHOUSE, Hobart Town.—English Flax in the Straw grown in Tasmania, and "Native Flax."

3005. J. A. SMITH, Napier.—Excellent specimens of N. Z. Flax and its Manufactures.

746. DR. LAUDER LINDSAY, Perth.—Specimens of Vegetable Fibres.

CLASS IV.

SUB-CLASS C.—VEGETABLE SUBSTANCES USED IN MANUFACTURES.

SECTION II.—WOODS.

JURORS.

J. M. BALFOUR, C.E., *Chairman*.

T. PATERSON, C.E. | C. P. O'RAFFERTY, C.E.
J. T. THOMSON, C.E. | T. R. HACKET.

THE duties of the Jurors on this Sub-Class would have been as onerous as important were they expected to report decisively on the comparative values of the fine collection of Colonial Timbers which has formed one of the attractions of the Exhibition, and thus in a great measure to determine what should and what should not be admitted in future public works in the Colony.

Circumstances, however, have rendered it impossible to give any such decided opinion, and have thus saved them from a grave responsibility; though in the interest of the Colony it is greatly to be regretted that more of the timbered portions of New Zealand are not adequately represented in the Exhibition, and especially that information of the valuable and import ant kind asked for by the Commissioners (as to durability under different exposures, &c.) has not been more freely forwarded.*

* WOODS OF CONSTRUCTION.

"For the purpose of Exhibition, it is desirable, in the article of timber, that the specimens in all cases should be converted into plank or scantling of such a size as to show its mercantile value. Longitudinal and transverse sections should be cut, and if possible they should be four inches thick, and cut so as to show the "sap" and bark on both edges. Moreover, since there is great uncertainty as to the origin of much colonial timber, it will be very desirable that each kind should be accompanied by a few twigs showing its leaves and flowers, as well as fruit, when procurable. If the leaves and flowers are pressed between sheets of paper enclosed in boards, they will furnish the evidence required.

From a want of more general information from all parts of New Zealand, and pending the completion of the experiments* undertaken by the Commissioners on the transverse strengths and other qualities of the timbers exhibited, nothing more can well be given here than a few general remarks on the prevailing characteristics of the colonial woods, with an occasional notice of any remarkable specimens, and the names of the principal exhibitors—all botanical and technical information being left to be incorporated with the results of the experiments.

Notwithstanding a few important omissions, the New Zealand woods as a whole, at least the best known varieties, are fairly represented; indeed there are probably very few which do not find a place in the Exhibition, either among the larger samples, which strictly fall under this Sub-Class, or among the smaller specimens of the various scientific collections. There cannot, however, be said to be a complete collection of the woods of any one Province or district of the Colony (except that of Dr. Hector's, among the botanical collections, which are included in Class XXIX.),† much less can the whole Colony be said to be, in this compre-

It is also desirable that, as far as possible, the following particulars should be supplied to the Commissioners with each specimen of wood:—

I. Name of the country, or colony and province, or district from which the wood was sent.

II. The botanical name, natural order, aboriginal name, and local name.

III. A short description of the tree, its abundance or scarcity in the district, colony, or country; the nature of the land on which it grows, whether swampy, hilly, or otherwise; its proximity to the coast, or a harbour, or navigable river, railway, road, or other facility for transport; the purposes for which the wood is applied in the country, and the estimation in which it is held for strength and durability under various circumstances, as exposure to atmospheric influences, immersion, partial or otherwise, in salt, brackish, or fresh water, underground, &c.; its capabilities for polish as a furniture wood, &c.; its cost in the colony or country per foot cube, and the diameter and height of trees as an index of the size of timber obtainable.

For the purpose of testing in a satisfactory manner, it is very desirable that not less than three repetitions of the same experiment should be made on each sample, so that a fair average result may be obtained, consequently it is recommended that the following scantlings should be furnished:—

Three samples, each 2½ inches square and 14 to 16 inches long.
Three samples, each 1½ inches square and 18 to 20 inches long.
Three samples, each 5 inches diameter or square, and 10 inches long.
Three samples, *cut across the grain*, each 8½ square, and 6 to 8 inches long; *or a sufficiently large block may be furnished to admit of these samples being cut from it.*"—Printed Paper, No. 12.—ED.

* These experiments have been completed since the report of this Jury was sent in. The result will be found in a tabular form, with all necessary explanations, in Appendix C.—ED.

† The admirable collection of the Woods of Otago (741), exhibited in the Otago Museum, one of the many attractive results of Dr. Hector's exertions, is very complete and instructive. Each specimen is polished to show the grain of the wood, and is accompanied with the bark, leaves, and flowers of the tree, and its native and botanical name, together with general information, in the Catalogue, as to the uses to which each is adapted. Not being included in Class IV.c., it is not strictly within the cognizance of this Jury, but they cannot refrain from commending its study to all practical men desirous of obtaining correct information as to the true names of New Zealand woods, and the best means of distinguishing between such varieties as are liable to be mistaken for each other, as well as learning their adaptability to cabinet work and other purposes.—(Vide Appendix C.—ED.)

hensive sense, even approximately represented; and as there can be no doubt that the varieties of climate and soil which are found in New Zealand must prove the source of very important differences in the qualities even of the same kind of timber when procured from places at a distance from each other—perhaps even to the extent of causing it to be rejected as almost worthless, or at least decidedly inferior, in one locality, while it is esteemed very highly in another—it may prove that any conclusions for or against any particular variety, resulting from the experiments made on the samples exhibited, may require to be considerably modified at a future period, when samples from other districts have been similarly tested.

In general character the New Zealand woods to a great extent resemble the growths of Tasmania and the Continent of Australia, most of the known varieties being harder, heavier, and more difficult to work than the majority of European and North American timbers. They vary however, very much among themselves; for instance kauri pine is a light free-working wood, very suitable for house carpentry, ships' decks, and similar works, and about the same transverse strength as Memel deal; while manuka (and perhaps a few others), when sound and well-grown, appear at least to rival the best specimens of Tasmanian blue gum, both in density and in transverse strength. Many of the less known woods also possess admirable qualities, and bid fair to be more used in future, when the districts in which they are plentiful shall have become more thickly peopled.

As a rule the New Zealand woods appear to be not so durable as the Tasmanian, at least stumps of felled trees seldom remain sound in this country for any length of time, and even the best fence posts hitherto in use have lasted but a comparatively short time; but it yet remains to be ascertained how much of this rapid decay is due to the careless felling of trees at improper seasons, and how much to climatic influences, which will equally affect imported woods. There are, however, varieties which are considered very lasting, and manuka, totara, black birch, kowhai, and matai or black pine, appear to be the most highly esteemed on the whole, though if arranged in the order of the esteem in which they are held, their names would probably occupy very different positions in different parts of the Colony. In the interior of Otago perfectly sound totara stumps are often to be met with, even on the tops of Ranges which have long been denuded of timber; undecayed buried trunks of unknown, but certainly great age, are also commonly met with, and even some old

snags in the Clutha River, now imbedded in the banks, *between wet and dry*, are as sound as ever, though worn into fantastic shapes by the long-continued action of the water. A portion of a Totara Stump (872), brought from the West Coast of Otago by Dr. Hector, and which there is every reason to believe to be the remains of a tree felled by Captain Cook's party in 1768, is also most interesting, as from its fresh appearance no one could imagine it to be the remains of a tree felled almost a hundred years ago. Among the other specimens are some samples of Kowhai, Manuka, and Miro, (537 App.), which have been cut from piles in the oldest part of Dunedin Jetty, and their perfect soundness after having been in the work for periods varying from twelve to fourteen years, may be instanced as a proof that these woods also are very durable under certain circumstances of severe trial.

From Auckland, C. and J. Ring, Kapanga Saw Mills (28), send very handsome samples of Waved and Mottled Kauri, and a very fine plank of Plain Kauri, four feet six inches broad, and one and three-eighths inches thick, remarkably flat and free from twist and warp, considering its large dimensions. R. B. Shalders (32), sends a Log of Kauri, also a good specimen; and F. E. Manning, Hokianga (30), samples of Native Cork Wood which are great curiosities, as the wood possesses a certain amount of transverse strength, and when carefully planed and smoothed with glass paper, has all the appearance of a perfect wood, while the specific gravity of one specimen is only .1325, so that it is actually little more than half the weight of an equal bulk of cork. It is used in the North Island for fishing floats and similar purposes, and is said to answer very well, though when constantly immersed, it has a tendency to become partially water-logged. This material would make admirable life-belts, fenders and linings for life-boats, and similar articles only liable to be occasionally wet; and its stiffness and lightness combined recommend its use for rollers on which plans and other valuable documents could be safely and economically transmitted by post.

From Hawke's Bay, C. Webber, C.E., Provincial Engineer, sends a number of very interesting samples (126, 127, 128), among which there are very large and handsome slabs of Totara, Rimu, and Black and White Maire.

From Wellington the Hon. W. Petre (206), sends a very complete collection of timbers for testing purposes, with the bark attached; and the Local Committee (205), and C. W. Hornblower (204), exhibit some handsome and well polished specimen boards.*

* One shewn by the Local Committee varnished with Kauri Gum; and by Mr. Hornblower with Rimu Gum. The price of the Rimu Gum Varnish is stated to be 21s. a gallon.—ED.

From Nelson, the only exhibit is a polished section of a Knot of Red Pine, curiously marked. An excellent proof that very handsome furniture veneers could be cut from well-selected samples of that wood.

From Canterbury, Banks' Peninsula, G. W. Holmes, C.E., sends three fine slabs (415, 416, 417), of White and Red Pine, and Totara, of large dimensions.

In Otago, Dr. Richardson, Dunedin (545), and C. M. Hammond, Port Chalmers (540A), J. W. F. Robinson, Wakatipu Saw Mills (546), and A. H. Ross, Dunedin (547), are the exhibitors of a number of interesting and valuable samples. Mr. Ross's specimens are remarkably well colored, large and handsomely marked planks of Red Pine admirably suited for cabinet work, table tops, &c., well polished, and certainly for such purposes the finest samples of red pine exhibited. The Marine Engineer's Department (537 App.), also sends a number of sections and specimens mainly to illustrate the comparative durability of the different varieties, especially when exposed to the ravages of the marine worm: also a number of sections illustrative of the growths of Clutha Island and the surrounding district, collected for the Exhibition with the kind permission of the various proprietors. In addition to these specimens, a number of samples have been furnished for testing purposes by various gentlemen in Dunedin, whose names do not appear in the Catalogue, but who have taken a warm interest in the result of the experiments.

The collection of Tasmanian timbers exhibited is both interesting and extensive, and certainly proves the right of that Colony to rank very high among the timber producing countries of the world. The specimens exhibited may be assumed fairly to represent the peculiar qualities of Tasmanian woods, which are probably as a whole inferior to none in density, toughness, and remarkable durability, as well as the ornamental varieties, in striking beauty. As illustrative of their durability, some specimens sent by Dr. Crowther (2825), may be specially instanced —among others, portions of stumps of Peppermint trees which have been felled 32 years, (the stumps remaining in the ground); a charred fence post of the same wood which has stood in "Burnt Island" for 38 years, and a sample of Blue Gum for upwards of 45 years portion of a sleeper in the old Hobart Town Court House—all these samples being, except on the surface, as sound as if they had been fresh felled. W. H. Burgess (2824) exhibits a portion of a Huon Pine flooring board which is still perfectly sound though it has been 45 years in the same building.

Dr. Crowther, Timber Establishment, Oyster Cove (2825), also exhibits

a number of specimens of Blue Gum, Swamp Gum, and Stringy Bark, and a great variety of other woods, some of the other samples being of ornamental appearance and well polished. For handsome woods, however, the fine collection sent by J. C. Boyd, Civil Commandant at Port Arthur (2823), must bear the palm, and deserves particular notice, both on account of the number and beauty of the samples. H. Lloyd, Hobart Town (2826), sends a fine specimen of figured Huon Pine. Jas. Risby (2831), a slab of plain Native Myrtle and a board of figured Huon Pine. Jas. Ross (2832) sends some fine samples of Blue Gum and Huon Pine suited for ship building. C. H. Miller (2827) sends boat planks of Macquarie Harbor Pine, and boat ribs, timbers and knees of Black Wood, She Oak, and Pinkwood.

Other useful specimens are sent by Messrs. Armstrong and Gourlay, Belbin and Dowdell, Grub and Tyson, Pritchard and Fisher, and Thomas Oldham (2821, 2822, 2825, 2830, 2828, and 2829), which are all well worthy of careful examination and give a fair idea of the extent and importance of the Tasmanian timber trade, and of the energy of the Hobart Town merchants

From New South Wales, Professor Smith, Sydney University, sends fourteen interesting and valuable specimens of the timbers indigenous to that Colony*. In general character, as might be expected, they greatly resemble the Tasmanian woods, but they are especially valuable in this Exhibition from the fact that experiments have already been made on the same varieties in 1861, by E. W. Ward, Esq., Deputy Master, Sydney Mint, and that a number were also previously tested at Paris in 1855, under the able superintendence of Capt. Fowke, R.E., so that these specimens will form a connecting link between the New Zealand experiments and those made in Australia and Europe. All those specimens which were large enough have been experimented on, and the details of their names, &c., will appear in the tabular results of the experiments (Appendix C); the following were too small for testing :—

1. Tulip wood (*Owenia venosa*), native name Mouliibie. A purely ornamental wood.

2. Mangrove (*Avicennia tomentosa*), native name Baalun, used in boat and ship building, for knees, &c.

3. Myall (*Acacia—pendula ?*), used for fancy articles, tobacco pipes, &c. Esteemed chiefly for its fragrance.

4. Colonial Beech (*Monotoca albeus*), native name Wallagunda ;

* Not in the Catalogue, having arrived too late.—ED.

grows chiefly on poor sandy soil, and is only used for mallets, tool handles and similar purposes.

5. Cherry tree (*Exocarpus cupressiformis*), native name, Coo-yie. The English name arises from the cherry-like fruit it bears, the stone, however, being always outside.

The only other woods exhibited are a very interesting collection of small specimens of Canadian Timbers, sent by the Board of Trade, Quebec, which well represent the staple export of that noble timber country, and cannot be too much admired—the American woods ranking among the very best in the world for lightness and ease of working, combined with a fair amount of strength.

These samples are too small to be experimented on, but this is the less to be regretted as the qualities of most, if not of all, the varieties are already well known.

J. M. BALFOUR, C.E., Chairman and Reporter.

HONORARY CERTIFICATES.

28. C. & J. RING, Auckland.—Specimens of Auckland Woods.
30. F. E. MANNING, Hokianga, Auckland.—Wood used instead of Cork for floats.
126. C. WEBBER, Napier.—Woods from Hawke's Bay.
415. G. HOLMES, C.E., Canterbury.—Woods from Canterbury Province.
546. J. W. F. ROBINSON, Wakatipu, Otago.—Woods of the Wakatipu district.
547. A. H. ROSS, Dunedin.—Woods of Otago.
2823. J. C. BOYD, Port Arthur.—Specimens of Woods of Tasmania.
2825. W. L. CROWTHER, Hobart Town.—Valuable specimens of Woods of Tasmania, illustrating their durability, &c.

Exhibitor who was also a Juror:—*

537 App. JAMES M. BALFOUR, C. E., Provincial Marine Engineer, Otago.

* If an exhibitor accepts the office of juror, no certificate can be awarded in the class to which he is appointed, either to himself individually, or to the firm in which he may be a partner.—*Decisions on points relating to the Exhibition*, 11 *(i)*.—ED.

CLASS IV.

SUB-CLASS C.—VEGETABLE SUBSTANCES USED IN MANUFACTURES.

SECTION III.—VEGETABLE EXUDATIONS AND MANUFACTURES THEREFROM.

JURORS.

J. A. EWEN. | J. BUTTERWORTH.
T. C. SKINNER.

UNDER this head are included the Gums and Resins, Gutta Percha, Caoutchouc, and their various applications to the Arts and Manufactures.

The forests of New Zealand contain many trees which yield resinous gums suitable for various manufacturing purposes. Foremost among these is the kauri pine (*Dammara australis*), the finest forest tree in the Colony, and yielding in the greatest quantity gum of commercial value. Although the kauri is not now found further South than Tauranga on the East Coast, and Kawhia on the West Coast, of the North Island, the gum is found imbedded in the soil in various other parts of the Colony, and it has been dug up even so far South as Stewart's Island, clearly showing that at one time the kauri flourished all over the Colony. The gum is also found in the coal-seams of the North Island. The kauri pine yields a large quantity of resinous gum, which at certain seasons exudes from the lower portions of the trunk, and from wounds caused either naturally or by the axe of the bushman. It is at first of almost the consistency and color of cream, highly glutinous, and with a not disagreeable flavor of turpentine. It gradually hardens with exposure, assuming various hues, from a cloudy white, bright yellow,

to a dark brown, and resembling amber very much in transparency and general appearance. When a kauri tree has been felled or cut, the place of severance is in a short time covered with this gum, which flows for a considerable time. When fresh it is often chewed by the Maoris, but for what purpose it is difficult to tell, as it does not possess any narcotic or stimulating properties. The newly exuded gum is of no commercial value; that exported is gum dug up from the ground on the site of old forests which have been destroyed by fire many years before. It is found from a few inches to as many feet deep, and in localities entirely denuded of trees, and also in the soil at the base of living trees; the gum in this case having flowed down the trunk and accumulated through many successive seasons. The pursuit of gum-digging is confined to the natives, to whom it has all the attractions that the search for gold has to Europeans. The natives assemble in large bodies, from various parts of the Colony, and work industriously at this profitable employment. The chief gum-yielding localities are situated at the North of Auckland, the greatest quantities being shipped in coasting vessels at Wangarei and other adjacent ports, whence it is conveyed to Auckland, and thence exported to England. The trade is a considerable one, and from the number of natives it employs, who generally dispose of it to local European traders, is a source of considerable profit to the settlers. Its market price varies according to the demand, from £10 to as much as £20 per ton, or even higher. It is worth a good price in England, and yields a very handsome profit to the shippers. For some time its uses were enveloped in a good deal of mystery, but it is now known to be employed for a variety of purposes. It is largely used in the manufacture of varnish, its qualities not being unlike gum copal; and of late years it has been consumed largely by cotton manufacturers for glazing calicoes and other goods. Recently a Company in London has commenced the manufacture of candles into the composition of which kauri gum enters largely. They are said to burn for nine hours, and to be no dearer than the ordinary sperm candles. It has been used by an Auckland manufacturer to varnish buckets, and when boiled with pitch makes an excellent application with which to preserve fences, or to keep out moisture from walls in damp situations. Kauri gum is insoluble in water. When in clear, large lumps, it can be carved into many beautiful forms; ornaments made from it have somewhat the appearance of amber. It burns readily, and emits a dense black smoke highly charged with carbon, and from it an excellent lampblack can be prepared. The Maoris used to employ this black in their tattooing

process. The supply of kauri gum is, however, rapidly falling off, and owing to the industrious digging of the Maoris and the gradual clearing of the kauri forests, it will at no very distant time become a rare commodity. Kauri gum is found embedded in the coal found at Drury, near Auckland, in small lumps and granulated pieces. The following figures show the quantity of kauri gum shipped from the Colony during the years 1853 to 1864 :—

QUANTITY AND VALUE OF KAURI GUM exported during the years 1853 *to* 1864.

	QUANTITY.	VALUE.
	Tons.	£.
1853	830	15,791
1854	1,661	28,864
1855	356	4,514
1856	1,440	18,591
1857	2,522	35,250
1858	1,811	20,037
1859	2,010	20,776
1860	1,046	9,851
1861	856	9,888
1862	1,103	11,107
1863	1,401	27,026
1864	2,228	60,590

Combes & Daldy (25), Auckland, and B. W. Gee (27), of the same place, exhibit interesting specimens of this valuable gum. The first-mentioned exhibitors are the chief exporters of Kauri Gum, and they have sent a number of large specimens, just as they have been dug up from the ground. Mr. Gee's samples are small assorted pieces classified into three kinds—clear, cloudy, and dark.

The application of Kauri Gum to ornamental purposes is illustrated by a rose executed in this material.

The Wellington Local Committee also exhibit wood varnished with Kauri Gum Varnish, which imparts a clear brilliant polish.

The Rimu *(Dacrydium cupressinum)* another species of pine, yields a gum suitable for varnish. A sample of Varnish manufactured from Rimu gum is exhibited by Chas. W. Hornblower (204), of Wellington, who can supply the article at twenty-one shillings per gallon. A specimen of wood varnished with this material shows the applicability of Rimu gum to this ornamental purpose. It has all the appearance of copal varnish.

The *Phormium tenax* yields a gum, which, as the method of treating the plant becomes more fully understood, will doubtless prove valuable. The root ends of the leaves of this plant are, at certain seasons, covered with a quantity of gummy matter of the consistency and appearance of strong size. This glutinous matter more or less pervades the whole plant, and in the preparation of the leaves for their fibre, this gum might be saved and utilised. James Mackay, of Nelson (315), exhibits a bottle of Gum made from the leaves of the *Phormium tenax.* It is useful for many ordinary purposes in which solution of gum Arabic is employed.

Many other New Zealand trees and plants yield resinous gums, but as no specimens were exhibited, and as they have not as yet any commercial value, no extended notice of them is necessary. The Black Mapau *(Pittosporum tenuifolium)* and the White Mapau *(Pittosporum eugenioides)* yield a gum resin, but not in quantity to make it valuable. *Panax Colensoi,* an ornamental tree with large trifoliate leaves, exudes a gum very similar to gum Arabic, and occasionally used for adhesive purposes.

The British exhibits of articles manufactured from Caoutchouc and Gutta Percha, and of those in the composition of which these substances are largely employed, are very numerous and interesting, and comprise a great variety of appliances and articles adapted to the use of colonists. The largest exhibitors are the India Rubber, Gutta Percha, and Telegraph Works Co., Limited, (2920), late Silver's India Rubber Works and Telegraph Cable Company, London. India-rubber and gutta-percha are now most extensively applied in the arts and manufactures, and the Company above mentioned have achieved a well-earned reputation for the excellence of the articles produced at their works. Perhaps the most important of the many applications of caoutchouc are in connection with steam engines and machinery, and the exhibits of articles of this description are well worthy of notice. They include—

1. Vulcanised sheet India-rubber, for cutting out Washers for steam joints, Valves for pumps, &c.

2. Ditto, Insertion for High Pressure, and where fineness is required in Joints, Gaskets, &c.

3. Machine Bands or Belting, of various strengths, for portable engines, steam ploughs, thrashing machines, chaff-cutters, malt or bean mills, &c.

4. Conducting Hose for light work, such as watering gardens, &c., where a light pressure only is required.

5. Delivery Hose, for conveying liquid manure, or other liquids where pressure is required; will stand a pressure of 30 lbs. to the square inch.

6. Delivery Hose, for brewers, &c., and purposes where the pressure does not exceed 75 lbs. to the square inch.

7. Delivery Hose for fire engines and heavy pressures.

8. Suction Hose with spiral wire for portable engines, pumps, &c.

9. India-rubber Tubing for grain and seed drills.

10. Gutta percha Tubing, for liquid manure.

11. Ebonite Tubing for liquid manure.

12. Glazed Ebonite Tubing for conveying gas, singeing apparatus, &c.

13. Ebonite Taps for acids, &c.

14. Double texture Waterproof Covers, for covering waggons, haystacks, portable engines, &c.

The value of vulcanised India-rubber for steam joints, packing for cylinders, &c., consists in its durability, elasticity, and capability of resisting heat. It is not liable to decay from corrosion, and its elasticity ensures a perfectly air or steam tight joint. It is extensively employed for these purposes in England. For driving machinery, the India-rubber belting cannot be surpassed, and for open belts, that is to say where they are not crossed, is more durable than leather, is lighter, exerts a more tenacious grip of the pulley, and is on the whole cheaper. This belting is made of a combination of canvas and vulcanised India-rubber, is not affected by heat or cold, and is admirably adapted for out-door work, such as driving thrashing machines, &c. The whole of the machinery in the Annexe was driven by this description of belting.

For all kinds of tubing where lightness, strength, and portability are required, India-rubber and gutta-percha are unequalled, and peculiarly adapted for various agricultural and manufacturing purposes, fire-engines, pumps, &c. The exhibits of articles suitable for these purposes, combine every desirable quality in appliances of this description.

The waterproof covers are in every respect superior to the ordinary materials generally employed for the protection of hay and corn stacks, waggons, &c., from rain, are much more durable and are thoroughly impervious to wet.*

* Class IV., Sub-Class C., Section 4, Dyeing and Tanning Materials. Vide Supplementary Report by Dr. Hector and Mr. Skey, Art. Tannin. Appendix A.—ED.

HONORARY CERTIFICATES.

27. B. W. GEE, Auckland—For Kauri Gum.

204. C. W. HORNBLOWER, Wellington—Varnish made from Rimu Gum.

25. COMBES & DALDY, Auckland—Kauri Gum.

2932. INDIA RUBBER, GUTTA PERCHA, AND TELEGRAPH WORKS CO. (LIMITED), London—Useful India Rubber and Gutta Percha Goods.

CLASS IV.

SUB-CLASS D.—PERFUMERY.

JURORS.

J. A. EWEN. | J. BUTTERWORTH.
T. C. SKINNER.

THE collection and distillation of the perfume of flowers is an art as yet little practised in the Colonies of Australasia, and there are but few indigenous plants or trees in New Zealand, the fragrance of which would be an agreeable addition to our list of perfumes. There are a few Colonial exhibitors who furnish specimens of perfumery prepared by themselves, from various concentrated perfumes imported from Europe.

T. W. Tatton, Nelson (316), exhibits a variety of Perfumes of an agreeable character, in addition to some tablets of Fancy Soap of his own manufacture.

T. M. Wilkinson, Dunedin (518), furnishes several specimens of Perfumery prepared by himself, the character of which is highly creditable.

Eugene Rimmell, London (2902), exhibits a case of Perfumery, comprising essences, toilet vinegar, pomade, soaps, and other manufactured perfumes, on which no further remark need be made than that they fully sustain the reputation of this celebrated perfumer. This exhibitor also shows an ingenious little apparatus called a Vaporiser, for perfuming apartments, valuable also for disinfecting sick rooms.

HONORARY CERTIFICATES.

316. T. W. TATTON, Nelson.—For excellent Perfumes.
2902. E. RIMMELL, London.—Excellent Perfumery.

CLASS V.

RAILWAY PLANT, INCLUDING LOCOMOTIVE ENGINES AND CARRIAGES.

JURORS.

T. PATERSON, C. E., *Chairman.*

J. M. BALFOUR, C.E. | C. P. O'RAFFERTY, C.E.
J. T. THOMSON, C.E. | T. R. HACKET.

THE articles exhibited in this important Class are very limited in number, and principally consist of specimens, and models of rails, chairs, and other articles for the permanent way of tramways, and railways.

Locomotive engines and railway carriages are unrepresented, except by a few lithographic drawings for an improved locomotive, intended for sharp curves and steep gradients.

As the articles usually comprised under the head of railway plant, being generally of considerable weight and bulk, are necessarily expensive and awkward to transport and fit up for exhibition, it is not a matter of surprise that this Class should be so poorly represented.

W. Bridges Adams, C.E., London (2917), exhibits Lithographic Drawings, and short description of Improved Locomotives, which are worthy of notice as being specially designed for use on railways with sharp curves and steep gradients.

The importance of the improvements suggested and attempted by Mr. Adams, is very great, and some of them have already been successfully carried out. Had they been better represented in the present Exhibition we should probably have been able to speak more decidedly regarding them, as it is we content ourselves with calling attention to them as praiseworthy efforts at improvement in a direction where there is sufficient scope for it.

J. Anderson, Canterbury (418), exhibits specimens of Tramway and set of Castings, for a Self-acting Turn-out and Crossing-point, in use upon an inclined tramway, at Thompson's Bridle Path Quarry, near Christchurch, Canterbury. The tramway consists of only one line of road, with a turn-out in the centre to admit of the ascending and descending trucks passing one another. The tramway is of the most primitive character, consisting simply of wooden rails, fastened to stone blocks, but the crossing point has been ingeniously arranged, so that the rope attached to the ascending trucks is protected, and runs in a groove at the crossing point, while the descending trucks pass over it into the turn-out, where the trains pass each other.

G. Holmes, C.E., Canterbury (420), exhibits a specimen of the Permanent Way laid down upon the Lyttelton and Christchurch Railway. This is a good specimen of an ordinary description of permanent way, on the transverse sleeper system, which, after innumerable trials and experiments, has been generally approved of and adopted by English Engineers.

R. Rutter, Hobart Town (2833), exhibits a Model and full-sized Specimen of Permanent Way, described as an "improved railway, substituting longitudinal sleepers and light rails for transverse sleepers and heavy rails." In the full-sized specimen exhibited, the rails of the ordinary double-headed form are supported between longitudinal timbers, each eight inches deep (8″), by six inches broad (6″), grooved on the inside to hold the central web and under portion of the rail between them. The timbers are fastened together by bolts, placed about three feet (3′) apart, passing through them underneath the rails, cross-ties being introduced at intervals of nine feet (9′), for the purpose of maintaining the guage of the line.

The principle of this description of roadway is not at all new, a much better example of it (invented by Mr. Bridges Adams), having been tried upon the Eastern Counties Railway many years ago.

The sample exhibited seems open to many objections, of which a few may be mentioned. The means adopted for fixing and retaining the rails in position seem insufficient, the joinings of the two baulks directly beneath the rails, will not form a solid bed for them to rest upon, nor to receive the vertical pressure, transmitted through the rails from the passage of engines, &c. The method of fastening the baulks underneath the rails appears insufficient to maintain the rails in a vertical position, and to enable them to sustain the lateral strain exerted upon them by the passage of engines, &c. When pressed upon by the rail, and especially at the join-

ings, the timber from its yielding nature would soon become crushed, and the rail quite loose, rendering the road insecure and dangerous.

The difficulty and expense of dressing and grooving the timber, so as accurately to fit the rails or curves, would be very great. From similar causes, the cost of renewals and maintenance would also be greatly increased.

Warners, Lucas, and Barrett (2918), exhibit some good samples of Pig-iron and Cast-iron Sleepers and Chairs. The sleeper is of a semi-spheroidal form, having a chair cast on its apex, and connected to the opposite sleeper by an iron bar.

De Bergue & Co., London (419), exhibit a model of Permanent Way, patented in England, which also consists of cast iron semi-spheroidal sleepers, laid with the apex downwards, the chairs being fastened to the rim forming the circumference of the sleeper, the opposite sleepers being fastened together by tie rods.

Cast-iron sleepers have been largely adopted on the Egyptian and Indian railways, and have been found to answer very well in tropical countries, where timber sleepers would have been rapidly destroyed by insects or by the influence of the climate.

2929.—Francis Morton & Co., (Limited), Liverpool, exhibit Model of Corrugated Iron Railway Carriage Shed, which possesses the advantages of simplicity and economy.

T. PATERSON, C.E., *Chairman*, Reporter.

HONORARY CERTIFICATE.

418. JOHN ANDERSON, Christchurch—Self-acting Turn-out and Specimens of Tramway.

CLASS VI.

CARRIAGES NOT CONNECTED WITH RAIL OR TRAMROADS.

JURORS.

SYDNEY JAMES, *Chairman.* | J. T. T. BOYD.

THIS Class of Exhibits, viz., Carriages not connected with Rail or Tramroads, as might be expected, is not numerously represented in the New Zealand Exhibition. The tastes and requirements for vehicles, in a new country, are necessarily varied and unlike those where roads have been long established and kept in the best repair.

In deciding on the awards in the Great Exhibition of 1862, the chief points attended to by the Jurors, were—

1. Suitability for the purposes intended.
2. General design and proportion.
3. Soundness and accuracy of workmanship, combined with good materials.
4. Improvement, if any.
5. Construction—no part unnecessary, and each adapted for its intended use.
6. Harmony in the colors employed for decoration.

548.—Exhibited and manufactured by H. Hoyt & Co., Dunedin, is a a double-seat, side-spring, open Albert Buggy. The fifth wheel, or centre check action, is supplied to prevent the fore-carriage from parting with the hind, in the event of a breakage. It has in addition an eccentric lock which will prevent the fore-wheels from locking under the hind carriage. The buggy is adapted for one or two horses, and the material and workmanship are of a very superior character.

Another buggy, technically called an Abbott's Mail Waggon, also manufactured and exhibited by the same firm, is a vehicle of very superior

construction, and on which the best skill of the smith has been brought to bear. The whole of the bolts, iron break, &c., are of excellent workmanship, and bear the closest inspection. This vehicle is well adapted for up-country use, and affords capacious stowage for luggage.

The Boston Chaise exhibited also by H. Hoyt & Co., is a well-made vehicle, and has the merit of strength and lightness combined. It is hung on leather braces, which prevent the shaking and sudden jars consequent on travelling upon bad roads.

550.—A single-seated Buggy with Hood, exhibited and manufactured by J. Robin, Dunedin, and hung upon elliptic springs, is well adapted for town work and good macadamised roads. The workmanship in this is also very good, and can bear inspection with any of the other vehicles exhibited.

A large American Mail Coach, exhibited by Henry Hoyt & Co., is an excellent specimen of the manufacture of the celebrated Coach and Carriage builders J. & S. Abbott, of Concord, New Hampshire, United States. It is constructed to carry 28 passengers with plenty of space, and room for luggage and mails. The timber used in its construction is all picked timber and well seasoned. After the parts of the coach are made in the rough, they are further seasoned by being allowed to remain in a place fitted with steam apparatus, where the temperature is raised to a great height. Before the vehicle is fitted, the strength and durability of all the parts are tested. The coach is known in America and these Colonies as the "Jack Coach," and only differs from other vehicles used as passenger conveyances in the mode employed for hanging the entire body upon large lever supports, called "jacks," on the fore and hind axles. By this contrivance the swing of the body, both perpendicularly and in a horizontal direction, is greatly moderated: in fact, the vibration of the vehicle is rendered scarcely perceptible. The lever of the double break is also very well worthy of notice; it is so simply worked that the driver can with ease check the rotation of the wheels when at the most rapid speed. In this vehicle, the king-bolt is arranged as a preventive bolt which enables the hind part to become detached in the event of accidental overturning. The extent to which these vehicles have been used in America and Australia, is ample proof of their utility and success.

HONORARY CERTIFICATES.

548. HENRY HOYT & Co., Dunedin.—Albert Buggy, of excellent design and workmanship.

550. J. ROBIN & Co., Dunedin.—Buggy of excellent design and workmanship.

CLASS VII.

MANUFACTURING MACHINES AND TOOLS.

JURORS.

JAMES M. BALFOUR, C.E., *Chairman.*

J. T. THOMSON, C.E. | T. PATERSON, C.E.
C. P. O'RAFFERTY, C.E. | T. R. HACKET.

THIS Class is somewhat sparsely represented, nor is it to be wondered at. Manufactures are not the natural productions of a new country where the cost of labor is necessarily prohibitive in the case of any article which can be imported at a reasonable price; the same reason, however, should largely encourage the introduction of manufacturing or *labor saving* tools of all kinds, especially those adapted for the conversion of timber, and it is greatly to be regretted that such tools are so poorly represented, more especially as in Dunedin there are now a number of beautiful examples of machines of this class in constant work.

SUB-CLASS *a.*—MACHINERY EMPLOYED IN SPINNING AND WEAVING.

This Sub-Class can scarcely be said to be represented at all, unless its limits be somewhat extended. A Cotton Gin (2919*a*) sent by the Cotton Supply Association, Manchester, is unfortunately imperfect, so that it is impossible to express an opinion on its merits, but the portions in the building are of good workmanship. Mrs. Alpenny, Dunedin (551) exhibits two of the hand spinning-wheels so commonly in use in Scotland and Ireland one or two generations back, and worthy of attention and perhaps of resuscitation in a country like this, where the wives and daughters of settlers in remote and inaccessible districts might profitably occupy their leisure time in spinning yarn for domestic use. Of *Sewing*

Machines which come more naturally under this Sub-Class than any other, there are three exhibitors. F. P. Smith of Hobart Town, exhibits a machine (2834) which appears to resemble closely those shewn by Thomas & Co. in the International Exhibition of 1862. The arrangements are not equal to those of some of the more celebrated makers, but it is due to the machine to state, that it appears to make very fair work, and as (apparently) a specimen of colonial workmanship it is worthy of careful examination. Stanford & Co., of Dunedin, exhibit an excellent collection of Singer's well known machines (552), and Wheeler and Wilson, London (2919), also exhibit a number of the beautifully finished noiseless machines constructed by them. Each of these forms of Sewing Machines is very perfect, and well known over the world. Those of Wheeler & Wilson, from their elegant simplicity, beautiful finish, and noiselessness, will certainly be always favorites for domestic use; while Singer's Machines, which are more powerful and suited for a much heavier class of work, will not easily be surpassed for manufacturing purposes, and it is at the same time due to them to state that they also appear to do fine and fancy work very perfectly.

SUB-CLASS *b*.—MACHINES AND TOOLS EMPLOYED IN THE MANUFACTURE OF WOOD, METAL, &c.

Of machinery for the conversion of timber there are but saw spindles and saw mills exhibited, and of these (554) J. Bullock's Patent Saw Mill is well worthy of notice, being simple and well adapted for bush work. The machinery has been made in Dunedin, and is of very fair quality and suited for heavy work.

The Saw Benches, with Circular Saws complete (2928), exhibited by Marshall, Sons & Co., Lincolnshire, England, are simple and in every respect well arranged and easily adjusted for cutting square or bevelled work of all kinds; one of these benches has been in very frequent use during the continuance of the Exhibition for the purpose of cutting up samples of timber for testing, &c., and has been found to work most satisfactorily.

A Saw Spindle is also exhibited by Ed. Mills, Wellington (208), manufactured in the Colony, and therefore worthy of note; and others by R. Blackadder, Dunedin, (556), but they do not present any remarkable features.

The machines for the conversion of metal are only represented by the exhibits of R. Blackadder, Dunedin, who shews (553) a Vertical Drilling

Machine, which is very simple and well arranged, a Lathe bed and heads, and some Saw Spindles; also a small Donkey Engine and some other articles which should properly be mentioned under Class VIII. The whole are well contrived and useful tools and the collection deserves careful examination.

Bread and Biscuit Making Machines are represented by (421) Stevens' Patent Family Bread Making Machine, and (422) Stevens' Patent Family Oven, which are exhibited by J. Woodford, Christchurch, and appear to be useful implements. Stevens' Bread Making Machines, of various sizes, were also exhibited by R. B. Martin & Co., Dunedin. Mrs. Alpenny, Dunedin, (551), also exhibits a Kneading Machine; and J. A. Steadman & Co., Dunedin, (570), exhibit several pairs of Biscuit Rollers, one of which is very complete, and arranged to cut out the biscuits and deliver them ready to be put in the oven.

J. M. BALFOUR, C.E., Chairman and Reporter.

HONORARY CERTIFICATES.

554. JOHN BULLOCK, Dunedin.—Patent Saw Mill.
552. STANFORD & Co., Dunedin.—Sewing Machines, "Singer's Patent."
570. J. A. STEADMAN & Co., Dunedin.—Biscuit Rolling Machine.
553. R. BLACKADDER, Dunedin.—Vertical Drilling Machine, Lathe, &c.
2919. WHEELER & WILSON, London —Effective Sewing Machines.
2928.—MARSHALL, SONS, & Co., Gainsborough.—Well-constructed Circular Saw Benches.

CLASS VIII.

MACHINERY IN GENERAL.

JURORS.

JAMES M. BALFOUR, C.E., *Chairman.*

J. T. THOMSON, C.E. | T. PATERSON, C.E.
C. P. O'RAFFERTY, C.E. | T. R. HACKET.

THIS Class is an important one, and though not very largely represented, there are still a number of very interesting articles exhibited.

Foremost in point of size and prominence, though not strictly an exhibit, may be mentioned the thirty horse-power side lever Engine built by Hawthorne & Co. of Leith, and imported by the Provincial Government of Otago as part of the machinery of a Dredger intended to be built for the purpose of Harbor improvement, and lent by them to the Exhibition Commissioners to drive the various machines exhibited in motion. This is a very well-proportioned engine, working very smoothly and quietly, and well repaying a careful examination.

569.—Manual Fire Engine and Hose, by Shand, Mason, & Co., of London, exhibited by the Royal Insurance Company, appears to be a well-finished specimen of the manufacture of these well-known makers, whose experience enables them to proportion the various parts so as best to combine all the varied requirements of the case.

2922.—Shand, Mason, & Co., London: Patent Vertical Steam Fire Engine. To the regret of the Jurors, this engine had been removed from the Exhibition, so that they are unable to report upon it.* The

* It was also a source of regret to the Commissioners. The agent who accompanied this Engine from London insisted on taking it out of the Exhibition for the purpose, as he stated, of publicly trying it. During the trial the engine became disabled, and the Commissioners consequently, declining any further responsibility, refused to re-admit it to the Exhibition. A very elaborate tabulated report of the numerous and carefully conducted trials of Messrs. Shand & Mason's Fire Engines, both manual and steam, under the direction of a special Jury, is appended to the Report

following statement from the exhibitors is printed in the Official Catalogue :—

"This engine is the same as those in use in the London Fire Brigade; it will throw 300 gallons per minute, through a jet 1⅛ inch diameter, to a height of 170 feet. Steam sufficient to work the engine can be raised in from nine to twelve minutes."

2921.—Weston's Patent Differential Pulley Blocks, exhibited by Alex. R. Hay, Dunedin, the agent for Nathaniel Mills, Birmingham, are specimens of perhaps one of the most valuable and important of modern mechanical inventions, being in fact the first *practical* application of the principles involved in the "Differential Axle," which, as explained in all elementary works on mechanics, besides other advantages, is capable of developing enormous power in a more simple manner than perhaps any other machine, but which till now has never been beneficially applied from its extremely limited range of action as ordinarily described. This objection is overcome in Weston's patent arrangement, by casting the two portions of the axle with grooves, and by using an endless chain passing over the grooves from opposite sides and hanging down in two loops or bights, in one of which there is a pulley, from the axle of which the weight to be lifted is suspended, while the other hangs free. The grooves of the differential axle or compound thereof are cast with projections of such a form that the chain cannot slip, and the difference in their diameter is carefully adjusted, so that the tendency to run down, caused by the slightly-increased leverage through which one inch of the chain (or one-half of the weight) acts, is counteracted by the friction of the whole arrangement, therefore the weight will hang in any position without being held. To raise the weight, that portion of the free loop or bight of the chain which comes off the larger part of the compound thereof is hauled upon; to lower it, that coming off the smaller part. These blocks are

on Class VIII., in the reports of the Juries of the International Exhibition, 1862; the result being that as Exhibitors of their Manual Fire Engine they were awarded a Medel for "good workmanship and excellent performance." With regard to their Steam Fire Engine, the report, signed by the Duke of Sutherland, and Captain Shaw, Superintendent of the London Fire Brigade, adds—"Messrs. Shand and Mason have produced an Engine at a cost of £650, weighing according to their statement 55 cwt., with jets and lamps, but without water, coals, suction-pipes, hose, or other gear; and capable of throwing in an available stream the following average quantities of water per minute:

"Distance	Angle	Quantity.
61 feet	10°	250 gallons
68 ,,	18°	165 ,,
82 ,,	14°	172 ,,
85 ,,	21°	137 ,,
102 ,,	11°	94 ,,
104 ,,	17°	19 ,, ."—ED.

now in very common use at home, and whether for simplicity of construction, ingenuity of design, ease of working, or power of holding at any point, they are beyond all praise. The only objection to them that has been suggested is, that when worn, their *holding power* will probably become much less to be depended on.

559.—Exhibited by Harnett & Co. of Dunedin, is a Guillotine Paper-cutting Machine, made by the patentees, Messrs. Dawson, Payne, & Co., Otley, England, which for perfection of design, smoothness of working, or elegance of finish, could not well be surpassed.

573.—Main's Patent Economic Printing Machine, exhibited by Mills, Dick, & Co. of Dunedin, is a very well made and easily worked machine, in which the cylinder oscillates as the type-table traverses, and they thus always work together. All the arrangements are good, and the machine is stated to be capable of working up to 1600 to 1800 impressions per hour.

572.—Wilson Brothers, engineers, Dunedin, exhibit a rough but well-contrived Hoisting Windlass, with an ingenious arrangement for altering the power. They also exhibit a Bottle-washing and a Corking Machine of simple construction, and a horizontally-arranged Wool Press, which is a very well designed and executed piece of workmanship.

There are four other Wool Presses in the Exhibition, one in an incomplete state from Wellington (209), by George Moore; one (1074) made by the New Zealand Iron Works Company, Dunedin; and two (2835) by J. and A. Clarke, engineers, Hobart Town: and the Jury not having sufficient experience of the practical working of such implements to be able to form a decided opinion as to the merits of each, requested the Commissioners to procure them the aid of one or more practical wool-growers, and Mr. M. S. Gleeson kindly consented to give them the benefit of his experience.

The result of Mr. Gleeson's examination is, that while all the presses are deserving of credit, and all possess good points and are of good workmanship, those exhibited by Messrs. Clarke of Hobart Town are the most complete, and that their screw wool press is specially deserving of an Honorary Certificate. He was of opinion that Messrs. Wilson's horizontal press was in many respects well arranged, but that it would take up too much room on the floor of the wool-shed, and also that it would not make such a neat bale as the vertical presses. The Hobart Town presses would in his opinion be improved were one side of the upper boxes made to open like the lower box, but divided into two horizontally, so that the packer

might be well supplied with air when at work in the press, while one door after another could be shut as the level of the wool became higher: with this alteration, he was of opinion that the press would be a very perfect one.

Mr. Gleeson also examined the Wool-washer invented by James Forsyth, Tokomairiro (558), and gave it great praise. He considered it decidedly worthy of an Honorary Certificate, as supplying satisfactorily a much felt want. The principle of this small machine is simple. The clean water is admitted at the bottom of the box, and the overflow is at the top of one end. This overflow drives a small water-wheel, which again causes an endless screen of cane-work to revolve. The action of the screen is such that all the wool which tends to escape with the overflow is caught and carried down by the screen (through which all the overflow must run, and which will revolve the faster the greater the overflow may become,) to the bottom of the box, where it meets the entering current, and by it is washed back again into the interior of the box. This ingenious arrangement promises effectually to prevent the loss of wool in washing, which has hitherto been considerable.

557.—A Lithographic Press, exhibited by Fergusson & Mitchell, Princes-street, Dunedin, and 571, another exhibited by the Chief Surveyor of Otago, present no points of novelty. There is also in the Otago Gallery a small "Waterlow's Autographic Press," (not numbered), exhibited by A. Eccles, which is very ingeniously contrived, and might often be serviceable in the office and elsewhere for throwing off circulars and similar work.

2834.—A Tobacco Cutter by T. P. Smith, Engineer, Hobart Town, is a well-designed and constructed machine, which performs its work rapidly and well, and must effect an immense saving of labor to manufacturers.

590.—Two Models of a River Screw to supersede undershot wheels, invented by William Paton, Dunedin, will be reported on by the Jury on Class IX. B., (Gold Mining Machinery, &c.), but as these screws, if really successful, would be applicable to any purpose where motive power is required near a river, they seem also to call for some remarks in this place. Ordinary paddle or undershot wheels are commonly in use on the Rhine and other Continental Rivers to work mills contained in barges moored in a tolerably rapid current, and these wheels are found to work very satisfactorily, being, as has been remarked, perhaps the nearest possible approximation to perpetual motion. These undershot wheels

working in an unconfined stream of course give but a small per centage of useful effect, but when the supply of water is unlimited, they afford a valuable propelling power. The river screws, of which rough models are exhibited, are proposed to be employed in similar situations, and there can be no doubt that they contain the *germ* of an idea which under certain circumstances, and when properly developed, may become important. One great advantage of such screws in a country like this is that they would be entirely immersed, or very nearly so, and that consequently they would not be liable to be interfered with by the heavy gales which so frequently pass over this Island, and which would be troublesome if ordinary undershot wheels, rising a number of feet above the streams, were used, though, as at present constructed, they would doubtless be surpassed in power by such wheels. The models themselves illustrate this, as they are barely turned by a stream which should make a model wheel revolve rapidly, and do an appreciable amount of work. It is stated that screws of this description have been found to answer well on the Molyneux, and it is certainly in their favor that their centre of gravity is so low that they can be easily floated in a condition of *stable equilibrium* by rough pontoons or casks, while an ordinary wheel would generally require a more expensive support.

J. M. BALFOUR, C.E., Chairman and Reporter.

HONORARY CERTIFICATES.

573. MILLS, DICK, & CO., Dunedin.—Main's Patent Economic Printing Machine.
558. JAMES FORSYTH, Tokomairiro.—Wool Washing Machine.
559. HARNETT & CO., Dunedin.—Guillotine Paper Cutting Machine.
572. WILSON BROS., Dunedin.—Ingenious Hoisting Winch.
2835. A. & J. CLARKE, Hobart Town.—Screw Wool Press.
2834. T. P. SMITH, Hobart Town.—Excellent Tobacco Cutting Machine.
2921. NATHANIEL MILLS, Birmingham.—Weston's admirable Differential Pulley Blocks.

CLASS IX.

AGRICULTURAL IMPLEMENTS.

JURORS.

T. R. HACKET. | J. KENNEDY.
ALEX. CAIRNS.

IN new Colonies, agriculture is generally the first industry to which settlers attach themselves. There is a sort of instinct which induces all classes to endeavour to get possession of LAND, and on becoming owners of this land, there is a strong and natural desire to improve this property, and make it of the greatest possible value. Hence, although farming is known not to be so profitable an occupation as many others in the Colony, we, in spite of this, find that a very large number of colonists have settled comfortably down on the land they have purchased, and that a large area of this land has been broken up for agricultural purposes.

The cultivated land in New Zealand was 382,655 acres, according to the Census of 1864, which quantity is rapidly increasing, and in fact appears to do so in almost geometrical ratio, each acre cultivated giving facilities for the breaking up of additional land at present waste.

The general progress of the Colony is a further inducement to agriculture. The modern system of farming connects agriculture with several branches of manufacture, the requirements of the farmer inducing him to employ the agricultural implement maker, whilst his produce employs the miller, the brewer, and in other countries the distiller also. It is greatly to be regretted, however, that in New Zealand distillation* has hitherto been prohibited by law, and thousands of tons of potatoes have been known to rot for want of consumers, which could not have happened had distillation been permitted. At the present moment, in outlying districts, potatoes are being offered at 10s. per ton, which will scarcely pay for digging them. This low price is caused by the distance of these agricultural

* As this sheet is at press, an Act permitting "Distillation" in New Zealand is reported to have passed the General Assembly.—ED.

districts from a market, and by the abundance of the crop; the bounteousness of Nature thus neutralising the value of her gift, or rather our fiscal regulations doing so, by preventing the farmer's disposing of his produce to the best advantage. Distillation would further permit the adoption of a greater rotation of crops, which would not only be a pecuniary advantage to the farmer, but would prevent the land being worn out by the constant succession of the same crops. It would also secure a permanent minimum price for any crop, however plentiful.

It is greatly to be regretted, with our extensive area of land fitted for agricultural purposes, and its variety of soils, that we are still dependent on other countries for the larger quantity of flour and most of the malt used in New Zealand: and there is the further consideration of the immense annual expenditure for fermented and spirituous liquors. The reason that agriculture has not kept pace with the population, is now principally owing to the gold-fields having induced a large immigration and consequent consumption of agricultural produce; but in the first settling of the Colony it was owing to the greater inducements for the employment of capital and labour in other occupations, especially that of grazing stock on the natural pastures, which gave immediate return: these pastoral lands were accessible on much easier terms than those offered to the agriculturist.

The number and variety of Implements exhibited connected with the Farm and the Dairy were very considerable, and show that attention is being paid in New Zealand to the mechanical improvements in aid of agriculture, by farmers, importers and manufacturers. Too many modern improvements were, however, missing at the Exhibition; amongst the more important, the Steam Plough, the Threshing Machine, and Hay Press, although all of these are in full operation in many parts of the Colony,—the reason being that at the time the Exhibition was held, these implements were required for practical use. There has been a very considerable improvement within the last few years in the implements used on the farm. This, with the increasing demand for those of a superior character, marks the progress being made; and the necessity there was for improvement in this is shown in the fact that the produce of the farm is now superior in quality and the returns more reliable than formerly. The want of these appliances was manifest in the wheat being inferior for the manufacture of flour, through the imperfect appliances for harvesting it.

The agricultural implements generally used in the Colony are those most in favour in Great Britain, and on the whole reflect much credit on

the enterprise of the New Zealand agriculturist, not only as regards the smaller class of implements, such as ploughs, winnowing machines, &c., but also the larger and more expensive, as steam threshing machines, steam ploughs, &c.

Almost the only implement not already introduced is the subsoil plough, although we think its use would be most beneficial. The turn-wrist plough would also be very useful in ploughing the sides of the hills, where very frequently the soil is superior in quality to that of the plains.

In reviewing the exhibits in this Class, the large extent to which we are dependent on the Home market for the supply of implements used on the farm, cannot fail to strike every observer. The greater facilities in obtaining the raw materials and the cheapness of skilled labor, combine to render our competing with the British Manufacturers, for a time at least, out of the question. It is, however, with much gratification that the Jurors report favorably on many exhibits manufactured in the Colony, which with the increasing demand for the higher class of implements, encourages the hope of the supply being met, at some future time, within the Colony.

The Exhibits comprise Ploughs, Scarifiers, Harrows, Horse Hoes, Sowing Machines, Reaping Machine, Threshing Machine, Portable Steam Engine, Winnowing Machines, Chaff Cutters, &c., &c., &c., Dairy Utensils, Cow-milker, Churns, Curd Mills, Cheese Presses, &c., &c.

The show of Implements, however, scarcely does justice as a representation of those in *use* in the Colony, nor does it place us in a position wherefrom to estimate rightly the progress that has been made, and the advancement attained, in this most essential industry. On referring to the statistics of the importations which are included in this Class, we find that in 1863, Agricultural Implements (ploughs, harrows, &c.), machinery for draining and threshing, were imported to the value of £50,458.*

Foremost among the Manufacturers in New Zealand we have Mr. Joseph Keetly, of Canterbury, whose Ploughs and Harrows deserve the highest mention for good workmanship and high finish; his ploughs are the only ones exhibited that were manufactured in the Colony; the other principal Exhibitors of Ploughs being Mr. Thos. Moodie, Agent for Barrowman, of Fifeshire, Scotland, Messrs. Baines and Oliver (importers), Messrs. W. Ball and Sons, &c.

The merits of the several ploughs were tested on a piece of lea-land kindly placed at the service of the Commissioners by Mr. George Hep-

* Details of Imports for 1864, are not yet published.—Ed.

burn, and a very full trial was given, which resulted in showing Mr. Barrowman's plough to turn out the best work.

On the first day's trial it was difficult to say whether Mr. Keetley's or Mr. Barrowman's plough was the better implement, so a second day's trial was given, on which occasion Messrs. Andrew Todd, J. B. N. M'Gregor, and — Gow, were associated with the Jurors. To secure the thorough testing of the ploughs, each plough was worked by three different ploughmen with their respective teams, and the result was in favor of Mr. Barrowman's, though the Jurors and Associates expressed a very high opinion of Mr. Keetley's plough, suggesting only some slight modification which they considered would greatly improve its efficiency. The wheel ploughs did not give satisfaction, with the exception of those made by Mr. Keetley, several of whose ploughs were arranged to be used as either wheel or swing-ploughs. There appears, however, to be a demand for wheel-ploughs, though the swing-plough has hitherto been almost exclusively used.

There was no representation of the Steam Ploughs which have been lately introduced and are at work both in Otago and Southland, nor were *Turn-wrist* ploughs exhibited, although, as already remarked, this kind of plough is so well adapted to the hill sides.

575.—Baines & Oliver, Dunedin, exhibit some excellent Ploughs and other implements.

581.—Murray, Kerr, & Co., Dunedin, exhibit Horse-power Threshing Machines from the well-known firm of Barrett, Exall, & Andrews, Reading. These were the only ones which appeared in the Exhibition, owing to the season of the year—others, which had arrived and were intended for exhibition, being more urgently required in the field.

422*a*.—Ball & Sons, per D. Hight, Canterbury, exhibit some very excellent implements, amongst which was a very useful Tip-cart, with moveable frame for loose hay, &c.; and "Bedford" Harrows, which the Jurors recommend for an Honorary Certificate.

1078.—James Muirhead, Dunedin, manufacturer, exhibits a set of Harrows of good workmanship.

Reaping Machines were exhibited by Messrs. J. A. Steadman & Co. (586), and Messrs. J. & T. Young per John Brown—(576). That exhibited by the latter firm was, in addition to their Turnip-sower, recommended for an Honorary Certificate for its simplicity of construction, excellent workmanship, and general efficiency.

2928.—Marshall, Sons, & Co., Gainsborough, Lincolnshire, exhibit a

seven horse-power Portable Steam Engine of excellent construction and workmanship, well adapted for agricultural purposes, and fully sustaining the reputation of the firm. The increasing demand for portable steam engines for farm purposes well proves their due appreciation in New Zealand.

Sowing Machines were not well represented, and in these, more perhaps than in any class of agricultural implements, are we behind the times.

An ingenious Hand Machine for sowing grass seeds, &c., was exhibited by John Logan, Dunedin (579). It is an American invention, and appears to be very efficient, being capable of sowing from four to eight acres per hour.

A Turnip-sowing Machine by J. & T. Young, per T. Brown, Taieri, (576), is recommended for an Honorary Certificate.

583.—H. E. Nathan, Dunedin, exhibits a Turnip-sowing Machine, well adapted to small holdings.

The Cow-milker exhibited by A. Eccles, Dunedin, is an American apparatus invented by Messrs. Kershaw and Kolvin, which is said to be in considerable use in English dairies. Seven or eight cows to the hour, and perhaps ten cows to a milker, are the usual allowance in England in the case of hand-milking; but, when this machine is in use, each milker may manage fifteen or sixteen cows within the hour. It is an ingenious example of the fertility of American invention, and received "honorable mention" at the International Exhibition, 1862.

Several Barrel and other Churns were exhibited, the former being generally used where butter is made to any extent, and these are manufactured in the Colony. That exhibited by M. Hall, Kaiapoi, Canterbury, (429), is recommended by the Jury for the improved method of securing the mouth, and general superiority.

The Patent Churns exhibited by George Kent, London (3003), are deserving of mention as very ingenious, and as producing butter in considerably less time than the ordinary churn.

The Curd Mill exhibited by H. Millward (582), and the Cheese Press exhibited by Gibson & Dickie (577), manufactured by J. & T. Young, Ayr, Scotland, were both very good, and were recommended for Honorary Certificates.

2929.—A very extensive collection of their manufactures in Galvanized Iron, suitable for agricultural and various other purposes, was exhibited by Francis Morton & Co., Naylor-street, Liverpool, under the care of their

agent for New Zealand, A. S. Braithwaite, C.E., Nelson. They comprised models of Iron Buildings, Church-house, Cottage, Store, Railway and other Sheds, Roof for Farmyard, &c., and Gates, Fencing, Wire Netting and Ropes, Telegraph Wire and Pole, Corrugated Plates, Roofing Felts, &c.

The Models of Buildings fall more immediately under the cognizance of the Jury of Class X., but the value of corrugated iron for buildings, sheds, and roofing, is too well understood throughout the Colonies, as evidenced by its extensive use, to make it necessary for this Jury to remark further than, that, where it is desirable to avoid extreme and sudden variations of temperature in closed buildings, the roofing felt would be found very efficient as a lining. The different kinds of wire, posts, patent straining-pillar, &c., for wire-fencing, so well displayed by Mr. Braithwaite, are very generally in use, especially in the Provinces of Nelson and Marlborough. They afford a complete illustration of the best description of wire fencing and all the appliances for erecting it. The galvanized wire cable strands were of very good quality, and appear more efficient than solid wire. They are made in long lengths of 500 to 1000 yards, and are said to make a cheaper fence and to be more easily put up; they can also be removed without injury to the wire. The patent winding straining pillar is self-acting, and "capable of straining 400 or 500 yards in one stretch round the sharpest curves and over most irregular ground." The Jury have pleasure in recommending Messrs. F. Morton & Co., for an Honorary Certificate for their Wire Fencing.

2929*a*.—Phillips & Hill, Birmingham, represented by their agents, R. B. Martin & Co., Dunedin. Here we have another extensive collection of materials for Galvanized Iron Fencing, &c., also well displayed. The twenty-six exhibits comprehend excellent examples of the Six-wire Cable Strand, Solid Wire, Flat and Round Bar Fencing; Sheep, Cattle, and other Hurdles; Sheep and other Galvanized Iron Netting; Rolled, Drawn, and Cable Strand Fencing Wires; Registered Tangential and Solid Straining Pillars for six wires; Wrought Iron Tubular Posts and Standards; Corrugated Roofing; Sheep Troughs, Buckets, &c. &c. All these goods were of very superior quality, and are of too well-known value to require further comment in a country where large districts, often of the best lands, are so destitute of "bush" as to make ordinary timber fencing very expensive both to construct and keep in repair. The Jury with pleasure recommend Messrs. Phillips & Hill for an Honorary Certificate.

1077 App.—A. C. Purdie, Dunedin, exhibits Wire Fencing, Wool-washing Cage, as well as various Flower Stands, &c., all of good manufac-

ture, and especially deserving of notice as being made in the Colony. Mr. Purdie is also recommended for an Honorary Certificate.

132.—John Begg, Otago, exhibits a "Contrivance of his own invention for straining Wire Fencing." It has the advantage of cheapness, and is found to be very useful on uneven ground. The Jurors considered it rough, but applicable for immediate repairs, the barrel appeared to be too small for any but superior wire.

133.—William Finlayson, Moeangiangi, exhibits a "tub for paying out wire in fencing," which appears to be a very useful contrivance for the purpose intended.

578.—R. Henry & Co., Dunedin, exhibit a number of well-finished Chaff-Cutting Machines. These machines are too well known to need further mention.

386.—J. A. Steadman & Co., Dunedin, Lawn Mower of very excellent construction, manufactured by Alex. Shanks and Son, Arbroath, N.B.

587.—Thomas Smith, Dunedin, Wheelbarrow, well-made, but possessing no novelty.

1209.—D. Anderson, Invercargill, exhibits a model of an Iron Plough, very neatly made.*

T. R. HACKET, Chairman and Reporter.

HONORARY CERTIFICATES.

423-427. JOSEPH KEETLY, Kaiapoi, Canterbury—Ploughs and Harrows.
580. THOMAS MOODIE, Dunedin—Barrowman's Swing Ploughs.
2929. FRANCIS MORTON & Co. (LIMITED), Liverpool—Wire Fencing.
2929A. PHILLIPS & HILL, Birmingham—Wire Fencing.
422. D. HIGHT, Canterbury, agent for W. Ball—"Bedford" Harrows.
576. J. BROWN, Otago—Reaping Machine, &c.
582. H. MILLWARD, Dunedin—Curd Mill.
2928. MARSHALL, SONS, & Co., Gainsborough, Lincolnshire—Portable Steam Engine.
429. M. HALL, Canterbury—Barrel Churn.
1077. A. C. PURDIE, Dunedin—Fencing, Wire-work, &c.
579. GIBSON & DICKIE, Otago—Cheese Press.
576. J. & G. YOUNG, Ayr, Scotland—Turnip-sowing Machine.

* The several Wool Presses exhibited are reported on in Class VIII., page 157; and the India Rubber, Gutta Percha, and Telegraph Works Company's exhibits of Belting, Hose, &c, &c. used on the farm, in Class III., Sub-Class C., Sect. 2, page 143.—ED.

CLASS IX. B.

GOLD AND OTHER MINING MACHINERY, TOOLS, AND APPARATUS.

JURORS.

T. R. HACKET. | VINCENT PYKE.

IN this Class are exhibited fourteen Models and one Machine in motion. To the exhibitors of these the jury would award Honorary Certificates, viz. :—J. Roberts (591), W. Ward (593), T. Rauft, and O. Bobardt (1076). The most important of these exhibits, considered not only as an entire novelty, but also as a contrivance of practical utility to the miner, is the "Model of a Windlass made to work a rope of any length, without choking the barrel of the same, for deep mining," by J. Roberts, of Dunedin, (591). This is an entirely original mechanical invention, and supplies a desideratum often sought by mining men on sinking a deep shaft, the eventual depth of which cannot be previously ascertained, or in sinking a small shaft to a greater depth than at first contemplated.

The invention consists in the application of two parallel barrels, in place of the usual single barrel, each of these having grooves (the one nine the other eight), sufficiently deep to guide the rope which encircles both. The one is turned by hand, the other revolves with the rope which it serves to guide in its oblique course.

The invention claims the following advantages :—

It is well known that in sinking a shaft with the usual "tackle" or "windlass" the length of the shaft, in its horizontal section, must be proportionate to its ultimate depth, on account of the travelling of the rope upon the drum on winding up the bucket. Thus, a windlass having a barrel eight inches in diameter, with a one-and-a-half inch rope, would require a length of 37 inches for the travelling of the rope when drawn

up from a depth of 10 fathoms, which, with the space taken up by the buckets and play required between them and the ends of the shaft, will amount to above five feet, which necessitates the shaft being constructed of this length (in its cross section), or, if deeper, of a proportionately greater length, which entails heavy expense, and makes the sinking by hand of deep shafts an unnecessarily costly undertaking.

A double rope or two ropes, each of a sufficient length to reach to the bottom of the shaft, has of late years been used in deep shafts, the requisite length of the windlass being decreased by allowing the lower part of the rope to wind upon the first coil; one half of the rope being wound on the barrel. This system has its disadvantages, as the drum or barrel on which the rope is wound becomes thicker as the bucket ascends, and requires greater exertion to turn it, besides considerably chafing that part of the rope first wound up, viz., the coil next the barrel.

In sinking deep surface shafts on extensive mines, a horse whim is often used, which supplies all requirements, entirely superseding this invention; but this is attended with considerable outlay and permanent expense, and is not applicable to "shafts" or "winzes" sunk from the drives or levels in the interior of the mine. By the present invention there would be no limitation to the depth of a shaft, from any causes connected with the winding of the rope, and the Jury feel convinced that it will be taken advantage of for sinking deep shafts both in this and other countries.

597.—J. Roberts also exhibits a Boring Tool for enlarging the cavity at the bottom of the hole bored in the rock for the purpose of blasting, by which a greater quantity of powder could be concentrated at the point required.

The Self-acting Dredge, exhibited by W. Ward, Dunedin (593), is a useful adaptation of a well known machine to the circumstances of New Zealand, and is intended for dredging the Molyneux, or any other rapid river containing auriferous sand, and extracting the gold therefrom. It consists of a punt with large paddle wheels, with an endless chain of dredging-buckets passing over a drum on the shaft or axle of the paddles. The method of working it is obvious. The punt is moored at a spot where auriferous sand is known to exist at a workable depth; the action of the current necessarily turns the paddles with their shaft, by which the dredging arrangement is set in motion—this draws the sand from the bottom, and delivers it a few feet above the deck of the punt, depositing it on a riddle supplied with water by a pump, also worked by the same

power. The sand is thus freed from stones, and passing through the sieves arrives at a sluice box on the deck worked in the usual manner, where the gold remains, the tailings being carried along the sluice into the river. The whole of the machine is self-acting, the power obtained by the paddles being applied not only for the dredging, but also for pumping the necessary water for sluicing, &c. It is probable that some modifications in the detail will have to be made when the dredge is practically tested. Amongst others, the advantages of working the buckets with or against the stream are not apparent.

Although the application of the force of a stream to the paddles of boats is of very old date, and is to be seen on an extensive scale on the Rhine, where dozens of flour mills are worked in this manner, and is also applied in America for ascending rapids, the Jury consider the adaptation of this power to dredging as particularly suited to the requirements of New Zealand, where rivers, altogether above 150 miles in length, are known to contain auriferous sand which can only be obtained by dredging; the old spoon dredges being the means at present in use.

The Jury would further suggest that this motive power might also be applied in forcing water, for the purpose of sluicing the terraces on the sides of the river where water cannot easily be obtained by means of the usual races. For this purpose a sort of floating Fire Engine would be required, worked by the action of the current on the same large paddles.

Two Models constructed by Theodore Rauft, exhibited by the Dunstan District Committee, deserve particular notice, as they are evidently prepared by a man of both practical experience and mining instinct.

The first Model (986) represents the German Claim, "a river bank claim on the Molyneux River, ten miles above Clyde," which is worked to a depth of several feet below the level of the surface of the water. In this is depicted a Californian pump, two varieties of cradles, with all the tools in ordinary use, and the figures of eight men engaged in the various occupations connected with the working of a "claim," showing the division of labor as practised by a party of gold-miners. The stratification of the auriferous drift, and the vegetation and nature of the surface are also very truly represented, giving the whole an appearance of reality. This model cannot fail to give a correct idea of the method employed in this branch of gold-mining, to the uninitiated; whilst to those acquainted with mining, the model is equally interesting on account of its complete correctness. The scale of the model is ⅜ inch to 1 foot.

The same mining artist has also contributed a "Model of Messrs.

Holt and Dakin's Lignite Workings, at Clyde." This model represents both the underground workings and surface arrangements of the Lignite mine now being worked in the township of Clyde, immediately on the margin of the Molyneux River. The natural surface is correctly represented with the characteristic steep slopes of the terrace, where this is cut into by the river. On the sides of the model are painted sections showing the various strata, and several beds of lignite (viz., three upper seams of eighteen inches thickness, and two lower seams of six feet thickness each), one of these latter is worked by the shaft shown in section, from the bottom of which a drift is shown following the direction of the strike of the coal, under the river. In the shaft the method of timbering and raising the coal are correctly represented, as also a working model of the pump and a water-wheel, the latter being supplied from a stream, by means of a race said to be several miles in length.

Several men are shewn at their various occupations,—mining, drawing, carting, and rafting timber,—giving the whole model an appearance of evident truthfulness, and showing that the constructor is well versed in all the minutiæ connected with mining.

A large Model of the Township of Alexandra with its vicinity, constructed by E. T. Brown, is exhibited by the District Committee of Alexandra (985). This model is a most natural representation of that important Digging town with its vicinity, and shows the two rivers Molyneux and Kawarau, at their junction with various races, sluicing claims, dredges, pumps, &c., with the whole of the buildings of the town in their exact colors and proportions. As a mining model, however, this is far less instructive than the two before described, although it gives a much better idea of the nature of the country.

1076 App.—Two Models of Puddling Machines are exhibited by the Commissioners of the New Zealand Exhibition, manufactured for them by O. Bobardt, of Melbourne. The one, a puddling mill of the usual construction, with harrows; the other, a puddling machine, with planetary motion, worked by two horses, which, although in practice highly effective, appears to the Jury too complex for general use.

588.—A Burdan Machine, exhibited by A. Cairns of Dunedin. This is of the usual construction, and is being employed for testing samples of auriferous quartz from various Reefs in the Province.

589.—Model of Fluming Hose on suspension wire, for carrying water across a gully, by J. Edmond, Dunedin. This model presents no novelty, the hose being in general use in various parts of the Province for carrying

water over the Clutha, Kawarau, and Shotover Rivers, several of these hoses being suspended for a length of 300 feet for the purpose of sluicing terraces where a sufficient supply of water cannot be otherwise obtained.

590.—Two Models of River Screw, to supersede undershot wheels, by Wm. Paton. These models are not constructed in accordance with the principles of the application of power by oblique action as laid down by Smeaton, and would therefore absorb a greater amount of force than otherwise.*

594.—Model of Sluicing Boxes, exhibited by Tuapeka District Committee. The only novelty presented by these is the application of a small undershot wheel to a puddling and amalgamating arrangement.

Several models of Amalgamators and Puddling Mills are exhibited by the Commissioners, which were constructed by O. Bobardt, Melbourne, but which present no novelty.

The Jury remark with regret that no quartz-crushing machines are exhibited, the more so as a great number of auriferous quartz reefs have been discovered in New Zealand, some of which are of very great richness, and which in all probability will give rise to a considerable industry.

T. R. HACKET, Reporter.

HONORARY CERTIFICATES.

591. J. ROBERTS, Dunedin—For Improved Windlass.

593. WM. WARD, Dunedin—Self-acting Machine for Dredging for Gold in rapid rivers.

—. T. RAUFT—Models of the "German Claim" and of "Lignite Workings."

1076. O. BOBARDT, Melbourne—Models of Mining Machinery.

* It must be borne in mind that these River Screws were invented for use in the rapid rivers of Otago, where any amount of power is continually running to waste. See also Class VIII., page 158. —ED.

CLASS X.

CIVIL ENGINEERING, ARCHITECTURAL AND BUILDING CONTRIVANCES.

JURORS.

J. MILLAR, C.E., *Chairman.*

W. H. CLAYTON | J. M. BALFOUR, C.E.

CLASS X. is one of the most important in the Exhibition, and it is gratifying to find that it is represented by so many important Exhibits, models, mainly of works either already completed, or now in course of construction in various parts of the Colony.

SUB-CLASS *a.*—CIVIL ENGINEERING AND BUILDING CONTRIVANCES.

The quality of the Engineering and Architectural structures of any country may fairly be taken as a measure of its civilization; and, tried by this test, New Zealand has no reason to hide her head. The peculiar nature of the country, and the great natural difficulties of communication, have called forth a corresponding amount of energy and skill in the Engineers entrusted with the management and development of her system of roads, while the haste with which the engineering structures required to be completed, and the stringent necessity for economy, though generally necessitating the use of timber and similar perishable materials, have at the same time justified, nay, compelled, the adoption of designs of a boldness and novelty, which would scarcely have been attempted in an older country. While a considerable number of models are in the Exhibition, it is certainly to be regretted that the engineering works of the Colony are not still more fully represented, as there are certainly many others the details of which only require to be better known, in order that they may be admired and appreciated.

317.—Perhaps the most striking of all the Models exhibited is that of Waiau Bridge, designed by John Blackett, C.E., Provincial Engineer,

Nelson. This bridge, which has been some time completed, is of a peculiarly light construction, being an open timber framework 100 feet high and 320 feet span at the level of the roadway, the whole being framed of a number of similar panels. The actual arch is of a pointed or gothic form, and 160 feet in clear span—being thus one of the largest in the Southern hemisphere, and certainly much the largest in New Zealand.

It is a "Horse Bridge," the roadway being 7½ feet wide, and it is carefully braced to ensure the necessary lateral stiffness. Of timber 30,550 feet, and of iron about 1120 lbs., were used in its construction, and the total cost is stated at £2200, or no more than about £6. 18s. per lineal foot of roadway. This is a very daring and successful structure, and, as seen in the beautiful water-color drawing of it exhibited by J. Gully, Nelson, resembles more a gigantic cob-web stretched across the ravine, than any production of human ingenuity. This Bridge is well worthy of an Honorary Certificate.

Drawings are also exhibited of a Horse Bridge over the Pelorus, and a Cart Bridge over the Maitai, at Nelson, from designs by the same Engineer, which appear to be well-arranged economical structures, and which have also stood the test of actual traffic for a considerable period, and are consequently worthy of careful study by all who are interested in such works.

35.—Model of a Bridge now being constructed over the Tamaki, at Panmure, exhibited by W. Weaver, C.E., Engineer-in-Chief of the Province of Auckland, appears to be an instance of careful design. The extreme length is 576 feet in 17 spans, with one swing-opening of 40 feet clear space at one side, to permit free navigation of the river. This is a very substantial and strong-looking bridge, but the spans are very moderate (about 30 feet), and the work apparently presents no peculiar difficulties.

597 & 598.—Models of Bridges now being constructed over the Clutha at Cromwell, and over the Gentle Annie Creek on the line of the Wakatip road, are excellent examples of a totally different principle of bridge construction, which was first introduced in America for timber structures, and is now very commonly adopted in iron for railway and other bridges, of large space, in different parts of the world. These bridges have been designed by T. Paterson, C.E., Chief Railway Engineer of Otago, and are on the lattice girder principle, in which the repetition of a large number of similar pieces of timber of comparatively small size, and skilfully combined with a due consideration of the various strains to

which each portion of the structure will be exposed, forms when completed and put together a girder of great stiffness and real simplicity, though apparent complexity.

The larger Bridge at Cromwell will, when completed, have a total length of 293 feet, the main span being 135 feet in the clear, and the total length of each girder (including a smaller side span), 233 feet, their total depth being 16 feet.

The smaller Bridge is similar in design, though with certain alterations, and the clear span will be 80 feet.

These Bridges, we understand, are now approaching completion, and they will certainly be very striking objects; the larger one especially, which spans the Clutha at a level of about 60 feet above that rapid river, at a point where the waters rush with great velocity through a contracted rocky gorge. As very excellent examples of careful design, thoroughly elaborated in every detail, we have no hesitation in recommending these models for Honorable Mention; indeed, we are only deterred from recommending them for Honorary Certificate from the feeling that that Award should only be bestowed on models of actually completed works, or such as embody some absolute novelty in their design.*

599.—Model of Puhetahu Bridge, designed and exhibited by S. Stratton, Dunedin, is also a timber bridge, but on a much smaller scale. It appears to be very fairly proportioned.

439.—" Model of an Improved Apparatus for allowing the expansion of Girders over the Piers of long Iron Bridges, and reducing the Oscillation produced by moving loads," invented and exhibited by W. T. Doyne, C.E., Christchurch and Melbourne, represents what we believe to be an important invention, though the model itself is not very clearly intelligible to an unprofessional eye. Mr. Doyne's idea is to *suspend* the end of the girder from a point practically above it, though really below the roadway, and he was led to devise the suspended link and radial slot arrangement in order to diminish as far as possible the lateral strain on the piers of those bridges especially, in which the piers consist of cast-iron cylinders of ample bearing power, but comparatively small diameter, and consequently small *lateral* stiffness. The suspension arrangement invented by Mr. Doyne will, we believe, meet the end in view, and as an important novelty, we consider it highly deserving an Honorary Certificate.

* This principle not having been recognised by other Jurors, the Commissioners have awarded Honorary Certificates in all cases where Honorable Mention was made of Exhibitors.—ED.

429*a*, 430, 431, 432, 432*a*, 433, and 434, may be grouped together. The first is a highly instructive and interesting Sectional Drawing of the Lyttelton and Christchurch Railway Tunnel by E. Dobson, C.E., and Julius v. Haast, Ph.D, &c., Provincial Geologist, Canterbury, showing the geological arrangement of the Port Hills, and is said to be the first instance in the world in which a geologist has been enabled to show a complete section of what is believed to have been the lip of a crater. 430, 431, 432, and 432*a* are exceedingly well executed and interesting Drawings of the Lyttelton and Christchurch Railway, by E. Dobson, C.E., the Engineer to the line. 433, a set of Lithographic Illustrations of the Construction of the Mont Cenis Tunnel; and 434, Map, shewing Proposed Drainage of Christchurch by E. Dobson, C.E., are also extremely interesting, and will well repay a careful study. Wc consider the series worthy of Honorable Mention.*

319.—"Model of Iron Roof, with metal—zinc, lead, or iron—in small pieces, to prevent cracking from atmospheric action:" patented by E. and R. Martin, and exhibited by Robert Martin, Nelson. The advantages of this roof are stated to be "watertightness, lightness, strength and durability, flatness, and economy," as well as great facility for the expansion and contraction due to variations of temperature. The arrangement exhibited is possessed of a considerable amount of novelty, and has good points, but we should be inclined to fear that the extra cost of construction implied by the necessary timber lining and the many folds and fittings, would greatly interfere with its general adoption. There are, however, situations in which this form of roof might prove useful.

2929.—Models of a Church, a Landowner's Country House, a Cottage, &c. &c., by F. Morton & Co. (limited), Liverpool, represented by A. S. Braithwaite, C.E., Nelson, are handsomely got-up specimens of a style of structure well suited for new Colonies. We do not consider iron buildings the best suited for the somewhat variable and windy climate of this country, however well they may be adapted for temporary purposes, and we believe that the time has passed for their general adoption; though in the more newly-settled portions of the Island such structures might be advantageously employed, at least for temporary purposes.

74.—Machine-made Doors, Sashes, and Mouldings of Kauri Pine, exhibited by the Union Steam Saw Moulding, Sash, and Door Company, Auckland, are very excellent productions of their respective kinds, and it

* Very full descriptions of these Works will be found in the Official Catalogue, p. 39, et seq.—ED.

is a matter for congratulation to find such superior Colonial work brought into competition with imported articles.

78.—Encaustic Tiles, &c., exhibited by Dr. Pollen, Auckland, are worthy of note as being an important step in the development of an industry new to this country. While still calling for considerable improvement, these works give promise of future importance.

1040, 1041, 1042.—The articles bearing these numbers all belong (as well as 78, mentioned above,) to Class XXXV., and will doubtless be reported on by the proper Jury; at the same time, some of the articles belong so exclusively, or at least are such important adjuncts, to "Building Contrivances," that we cannot pass them over in silence. The articles exhibited are entirely manufactured in the Province of Otago, and consist mainly of Bricks of various sorts, Ventilating and other Tiles, &c. &c.; and we have great pleasure in bearing testimony to the immense amount of progress indicated by the various samples. Fortunately it does not lie with us to decide—a difficult task—which manufacturer should bear the palm.

There is one other article which belongs equally to this Sub-Class and to Sub-Class C., "objects shown for their architectural beauty," viz. the various samples of Ransome's Patent Stone exhibited by Ransome's Patent Stone Company, London. These do not appear in the Catalogue, but they must have attracted the notice of many, and we consider them in every way worthy of the highest praise. Whether as a substitute for a first-class freestone in the face-work of city buildings, or as an inexpensive material in which can be produced by moulding all the architectural effects of high-class carved work and similar decorations, this composition will be equally valuable and available. The Company is well entitled to an Honorary Certificate.*

SUB-CLASS *b*.—SANITARY IMPROVEMENTS AND CONSTRUCTIONS.

This Sub-Class is, we regret to say, but sparsely represented—owing we believe in a great measure to the non-arrival, till too late, of valuable consignments intended for exhibition. To it belong the Ventilating Tiles (1040) already referred to, as well as a very fine collection of Ventilating Tiles, Air Bricks, Drain Pipes, Air Traps, &c. &c. (2999), manufactured by Doulton & Watts, London, and exhibited in the English Court. All these articles merit careful examination, and are creditable alike for design and execution.

* See also Appendix A., Art: Building Stones, Sec: Freestones.—ED.

440.—Model of Moore's Patent Louvre Glass Ventilator, exhibited by the agent for Canterbury, J. Woodford, is a well-known and efficient sanitary contrivance which does not require any special praise from us, its reputation being already well established. A. Eccles, Dunedin, also exhibited Moore's Patent Ventilator itself.

595.—A Wash-hand Stand, fitted for hot and cold water, is an exceedingly well-contrived and excellently-finished article, made by A. & T. Burt, Octagon, Dunedin, and worthy of Honorable Mention. The same firm exhibit a Water-closet and two Pumps, which are very good of their respective kinds, but possess no points of novelty.

596.—Park & Curle, Dunedin, exhibit a Fountain and Pumps, the former being a good specimen of the moulder's art, the latter fair examples of the ordinary class of work.

SUB-CLASS *c*.—OBJECTS SHOWN FOR ARCHITECTURAL BEAUTY.

The only exhibits coming in any way under this Sub-Class which call for special mention, with the exception of some of the specimens of Ransome's Patent Stone, already alluded to, are 441 and 442, Rubbings from English Mediæval Monumental Brasses, exhibited by R. Speechly, M.R.I.B.A., architect, Christchurch. These are well-executed and interesting fac-simile representations of early art.

JAMES M. BALFOUR, Reporter.

HONORARY CERTIFICATES.

317. JOHN BLACKETT, C.E., Nelson.—The Waiau-ua Bridge, (for the daring design and its economical completion.)

439. W. T. DOYNE, C.E., Christchurch.—Apparatus for allowing the Expansion of Girders over piers of long Iron Bridges, (for the novel and ingenious method to allow for expansion and reduce oscillation.)

598. T. PATERSON, C.E., Chief Railway Engineer of Otago.—Models of Bridges over the "Gentle Annie" and Clutha, (for their skilful design and excellent proportions.)

430. E. DOBSON, C.E., Christchurch.—Plans and Sections of the Lyttelton and Christchurch Railway, and the Proposed Drainage of Christchurch, &c.

——. RANSOME'S PATENT STONE COMPANY, London.—Specimens of Ransome's Patent Stone.

595. A. & T. BURT, Dunedin.—Wash-hand Stand, with ingenious arrangement for the supply of hot and cold water, of excellent workmanship.

CLASS XI.

MILITARY ENGINEERING, ARMOUR, ACCOUTREMENTS, ORDNANCE, AND SMALL ARMS.

JURORS.

J. T. T. BOYD, CAPT. | W. B. GRAHAM, CAPT.

SUB-CLASS *a.*—CLOTHING AND ACCOUTREMENTS

THE only Exhibitors in this Sub-Class were (2935) Silver & Co., London, the well-known Outfitters, who sent a few examples of serviceable Uniforms and Accoutrements, adapted for Volunteer Rifle Corps, but which do not call for any special notice.

SUB-CLASS *b.*—TENTS, &c.

It is somewhat remarkable in a country such as New Zealand, where Tents are in such extensive and constant use even in civil life, that not a single one was exhibited.

SUB-CLASS *c.*—ARMS AND ORDNANCE.

A collection of Small Arms exhibited by James Mills, Dunedin (601), perhaps more remarkable for their history than any great novelty in their construction, though including the Short Enfield, Whitworth's, Henry's, Aston's, and some foreign Rifles, some Smooth Bores, and a considerable number of Pistols; a Spence's Repeating Rifle, and a Carbine exhibited by St. John Branigan, Dunedin (602); and one Twelve-pounder Armstrong Field Gun, with Limber, Ammunition Waggon, &c., complete, are the only exhibits in this Sub-Class; nor is this a matter for surprise in an Exhibition held in the Middle Island of New Zealand, happily hitherto free from dread of foreign aggression, and from any possibility of Native disturbances, such as unfortunately seem chronic in the North Island.

Mr. Mills' Exhibits include—

1. A Massachusett's Rifle—a Small Bore sighted for very long ranges, and generally used by the hunters and trappers of the Backwoods of America.

2. Aston's Rifle, a modification between a Whitworth and a Henry.

3. Whitworth Rifle, (Government size), hexagonal bore. This splendid weapon is too well known to need any comment.

4. A German double-barrelled Rifle of highly finished and most elaborate workmanship.

5 and 6. Henry Rifle, and a Short Enfield, (both of Government size). These celebrated arms are also too well known to need further description.

7. A double-barrelled Smooth-bore, of Mr. Carrick's manufacture. Very well finished.

8. An old Flint Revolver Rifle, taken from the celebrated Maori Chief "Bloody Jack," about fifteen years ago. The rifle is in excellent condition, and the workmanship in it is considered by experts to be remarkably good.

9. A Duck Gun, manufactured by Mr. Mills.

In addition to the foregoing, Mr. Mills exhibits a large number of Pistols, some curious from their antiquity, and others interesting as shewing the very latest improvements made in these arms, both in England and America. Of these there are—

1. A pair of Pistols (flint-lock), over 100 years old. They were in the possession of Col. McKenzie, and are known to have been used in Lord Clive's memorable battles in India. They are of excellent manufacture and finish, and all the material parts of the weapons are almost equal to anything that is made at present.

2. A very old Turkish Pistol, peculiar only from all the lock-smith's work being on the exterior of the piece.

3. A French Self-priming Pistol.
4. A large "Tranter," No. 1 size.
5. A small "Tranter," No. 3 size.
6. A small "Whitney."
7. The Original Revolver.
8. Colt's "Model Pistol." His latest Improvement.
9. Sharp's latest American Improvement.

With these weapons were exhibited Bullets, Bullet-moulds, Flasks, &c., &c., and a number of Native War Instruments, the whole forming a Trophy reflecting great credit on the Exhibitor.

602.—The Spence's Repeating Rifle exhibited by St. John Branigan, Dunedin, is both a breech-loader and a repeater. In a magazine situated in the butt of the gun, seven cartridges are securely deposited at each loading. These are thrown forward to the chamber with unerring precision, permitting such rapidity of firing as leaves nothing on that score to be desired.

The Armstrong Gun is one furnished by Government for the use of the Dunedin Volunteer Artillery. It is the ordinary service twelve-pounder Field Gun, which has obtained such a high character wherever it has been used. The extreme accuracy necessary in the manufacture of rifled cannon is well shown by the gauges used at the Royal Gun Factories, which are constructed to dimensions, some of which read in inches to three places of decimals.*

The Armstrong Segment Shell also exhibited, is the only projectile now used with Armstrong Field Artillery. For the twelve-pounder gun the shell consists of two thicknesses of metal, the outer layer being in a single piece, and the inner built up, of 48 segments, held together by an interior coating of lead, which forms the chamber for the reception of the bursting charge.

HONORARY CERTIFICATE.

601. JAMES MILLS, Dunedin.—A Duck Gun, (manufactured by him, and the interesting collection of Arms exhibited by him.)

* An interesting description of the manufacture of Rifled Cannon is given in the Report of the Jury on Class XI., at the International Exhibition, 1862.—ED.

CLASS XII.

NAVAL ARCHITECTURE, SHIPS' TACKLE, &c.

CONSIDERING the extent to which ship-building is carried on in various parts of New Zealand, it is a matter of surprise that so little has been done to illustrate this important branch of industry in the Exhibition. With the solitary exception of a small Pleasure Yacht, exhibited by T. Fisher, Dunedin (608), the exhibits consisted merely of models, unaccompanied by any description. So far as illustrating naval architecture, some of these were interesting; but had the models referred to vessels built in the Colony, they would have been more valuable.

The timber trees of New Zealand supply excellent material for ship-building. In the North Island, knees and timbers are constructed of the limbs and roots of the Pohutakawa and Puriri, whilst the Kauri supplies deck and side planking. In the Middle Island, Totara and Red Pine (Rimu) are chiefly employed; and in Stewart's Island, the magnificent Red and Black Pines with which the forests of that island abound, provide the ship-builder with the best timber for his purposes.

Auckland ranks pre-eminent amongst all the ports of the Colony for the extent of its ship-building and the reputation of the vessels built there. In fact it may be considered as the only port in New Zealand at which ship-building is carried on to any important extent. Vessels varying from 10 to 400 tons are constructed in the three ship-yards which are established, and some of them have deservedly been very highly spoken of. Auckland supplies many vessels to the Australian Colonies, and most of the numerous fleet of coasting craft in this Colony have been built in the ports of Auckland or Manakau. Several large vessels have been built at Hokianga, Matakana, and the Great Barrier Island, where the proximity of large timber affords superior facilities for their construction. In some of the small ports of the Wellington Province, vessels of small tonnage are also built. Akaroa and Otago in the Middle Island, and Pater-

son's Inlet in Stewart's Island, are the principal ship-building ports; but, with few exceptions, the vessels built are of small size, for the coasting and harbor trade.

Two or three small steamers have been constructed at Auckland and Manakau, built of wood, and fitted with engines by local manufacturers. Two iron steamers, sent out in parts from Britain, have been constructed at Dunedin, and one has been entirely built by local artizans. Two wooden paddle steamers (one a stern-wheel) have also been built at this port, and another is now building. Boat-building is general at every considerable port, and some excellent specimens of the boat-builder's art have been produced.

It is to be regretted that the entire absence of any official statistics on the subject renders it impossible to give the number or tonnage of the vessels built in New Zealand.

The exhibits comprised the following:—

134.—Henry Morrison, Hawke's Bay: a Model of a Life-boat of good principle.

210.—George Houghton, Wellington: Model of a Ship.

211.—Daniel M'Intyre, Wellington: Model of a Ship.

600.—J. Edmond, Dunedin: Flags.

603.—John Domico, Dunedin: Model of a Ship.

604.—Louis James, Dunedin: Model of a Ship.

605.—Thomas Robertson, Port Chalmers: Models of Steam-boats.

606.—Joseph Swan, Port Chalmers: two Models of Ships.

607.—Charles Clifford, London, Model of his Boat-lowering Apparatus. This admirable, because useful and efficient apparatus, was well illustrated by a working-model exhibited in action by the Inventor's brother, Mr. G. P. Clifford, Dunedin. It has now been in practical use for several years, and saved many lives in various parts of the world. Within the past year the absence of such a means of speedily and safely lowering and disengaging a boat, has been felt on board several vessels on the coasts of New Zealand, and from the want of it lives are not seldom lost. It is so inexpensive, and its mode of action so extremely simple, that it would be well were the adoption of this or some equally efficient plan made compulsory on all ships. Mr. Clifford obtained a medal for his meritorious invention at the International Exhibition, 1862, and is well-entitled to an Honorary Certificate for his invention.

608.—T. Fisher, Dunedin: Models of Yachts and Boats, and full-sized Pleasure Yacht, constructed entirely of the woods of the Province.

609.—George Saunders, Port Chalmers : a pair of Waterman's Sculls.

610.—Small Model of Martin's Patent Anchor exhibited by Captain Randall, P.N.Z. and R.M.S.S. Lord Ashley. This anchor is on the "detached part" principle. The arrangement of its parts "provides for both flukes and arms being in the ground at the same time," so that even with small weight it possesses great holding power. At the trials before the members of the Trinity House, Newcastle-on-Tyne, it was reported on very favorably; many shipmasters also speak favorably of it from their experience, and it received a medal at the International Exhibition, 1862, for its "novel and ingenious form," and Captain Randall, as the Exhibitor, received an Honorary Certificate.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

605. THOMAS ROBERTSON, Port Chalmers.—Models of Steamers.
607. CHARLES CLIFFORD, London.—Patent Boat-lowering Apparatus.
608. THOMAS FISHER, Dunedin.—Yacht and Models.
610. CAPT. RANDALL.—Martin's Patent Anchor (Model).
600. J. EDMOND, Dunedin.—Flags.

CLASS XIII.

PHILOSOPHICAL INSTRUMENTS, AND PROCESSES DEPENDENT ON THEIR USE.

JURORS.

JAS. M. BALFOUR, C.E. | JOHN MILLAR, C.E.
T. PATERSON, C.E. | A. H. ROSS.
EDWIN JONES.

CLASS XIII. is a very comprehensive and important one, and it is exceedingly difficult to define its precise limits.

These limits are indeed ever varying, the Philosophical Instrument of one age often becoming the common tool, or still more common toy, of a succeeding generation.

It was scarcely to be expected that this Class should be very fully represented, as the requirements of the professional man rendered it impossible for him to spare for a long period the implements he might have need of from day to day, and as there are certainly but few such instruments to be found in the Colony other than those in frequent use. It is in consequence a matter for congratulation that the Exhibition contains so much that is interesting in this Class, and above all so much of novelty,—some of the exhibits being worthy of a foremost place in any part of the world, and at least one instrument having been invented in the Colony which for simplicity and efficiency is beyond all praise.

612.—*The Light-house Apparatus designed for Cape Saunders* is a magnificent example of a true combination of scientific knowledge with the highest practical skill. It belongs to the Dioptric system, invented by the celebrated French philosopher Augustin Fresnel; but the glass spherical mirror connected with it is of British invention, and is absolutely new,—the one exhibited being the first of the size ever made, and it is believed to be still unique.

The history of light-house illumination is lost in antiquity, but it is pretended, with some show of plausibility, that the Pharos of Alexandria, which was built about 300 years before the Christian Era, was lighted with oil lamps. If this be correct, this art, like many others, must have been for a time lost, for, coming to comparatively modern times, we find that wood fires were used in light-houses, and that the adoption of coal instead of wood was the first improvement. When the present magnificent light-house on the Eddystone was completed in 1759, the science of light-house illumination was so imperfect that no better means could be found to light it up than a hoop full of tallow candles.

Towards the close of last century paraboloidal reflectors became generally adopted by public bodies, though in many of the patent lights, which were the property of private individuals, the progress of improvement was more slow, and coal fire lights were not finally disused till some time after 1816.

Reflector Lights were gradually brought to great perfection, and indeed are still common, but they have certain disadvantages, and to overcome these, Augustin Fresnel, about 1818, invented the Dioptric system, the principal merits of which are the substitution of highly wrought, splendidly polished, and untarnishable surfaces of an almost imperishable material for the silvered reflectors, which require continual polishing, are liable to wear out, and always become more or less dented and shapeless in course of years. M. Fresnel at the same time, in conjunction with others, perfected his system by inventing the compound wick Lamp, which produces a large sized and tolerably concentrated flame. Since its first invention the dioptric system of illumination has been gradually perfected and many improvements made, both in the design and the execution of the various parts ; and none have labored so successfully as Thomas Stevenson, C.E., of Edinburgh, a member of a family for three generations identified with Lighthouse progress, and designer of the Apparatus exhibited, and Messrs. Chance and Co., Glass Manufacturers, Birmingham, the manufacturers of it.

In the centre of the Apparatus exhibited, is the mechanical lamp, in itself an interesting and beautiful object. It has four concentric wicks with air spaces between them, and a clock-work action which continually pumps up oil while the lamp is burning. The pumps are arranged to force up much more oil than is consumed, the surplus being allowed to overflow the burner, and run back again into the cistern below, the object of this being to keep the wicks and burner cool. This overflow is so

necessary, that where by accident it has failed, the tinned work of the burner has been known to be almost instantly melted. Surrounding the lamp is the apparatus proper, consisting in this case of rather more than half a circle of dioptric fixed light apparatus of the first order (or largest size), and rather less than half a circle of dioptric spherical mirror. The front part, or dioptric apparatus proper, which entirely surrounds the lamp *to seaward*, consists technically of an upper and lower set of prisms ("hyperpyral" and "hypopyral" as they have been named), and a central or refracting belt. The refracting belt resembles in all its vertical sections the central section of a lens, and consequently in all vertical planes it has lenticular action. The upper and lower prisms are practically reflectors, and were represented in the earlier instruments by silvered mirrors, the prisms having been more recently adopted on account of their greater durability and smaller absorption of light. (It has been experimentally established that very nearly one half of the light falling on a silvered reflector, is dispersed or absorbed, the light after reflection being little more than half as powerful as before; while after passing through the lighthouse prisms eight-tenths of the whole light is still available to benefit the mariner. This shows an advantage of three-tenths nearly in favor of the dioptric apparatus.) In a fixed light apparatus like the one exhibited, every *horizontal section* will shew *parallel surfaces* like plate glass, and consequently while the refractor and prisms bend down to the horizon all rays which would be wasted on the heavens, and up to the same point all rays which would fall on the earth, it has *no horizontal action*, but allows the light to diverge naturally in all directions, and thus to be always and everywhere visible on the sea, whence the name—"Fixed." Formerly, when a light was situated on a headland, and did not require to be seen all round the horizon, it was customary to reflect the light which would be wasted on the land back through the flame by a metallic spherical mirror, but when the advantages of glass over metal became fully recognised, it became obviously desirable to introduce glass reflectors also. This problem was a very difficult one, as the light required to be actually returned to the point it emanated from, and not merely deflected from 30 to 90 degrees, as had been already done. This desirable improvement was at last effected by Mr. Stevenson, who invented a form of prism nearly resembling two of the ordinary prisms joined together, and in which every ray of light is *twice reflected;* but there were many practical difficulties in the way, and it was not until Mr. James Chance brought his great mathematical knowledge and practical skill to bear on the question that these

were overcome, which they eventually were by the adoption of valuable flint glass of a high refractive power, and by a certain modification of the mathematical elements of the problem.

The dioptric system of light-house illumination is now very perfect, but it bids fair to be soon completely altered. Even now, at Dungeness in the English Channel, an electric light is regularly exhibited of such enormous power that when first tried, observers at a distance *could not discover any difference* when the old first order light beside it was *extinguished and relit.* The light is produced on the magneto-electric system, the machinery being driven by a small steam engine; and thus the most powerful and perfect light of modern times is, like the miserable beacon of our ancestors, solely produced *by the consumption of coal!* So much does science work in circles. The new magnesium wire light is stated to be very intense, and may also eventually be found suited for light-house purposes. Should either of these intense lights become commonly adopted, the present apparatus will become obsolete, as its great size is only rendered necessary by the size of the lamp flame, (which when carefully tended is 3½ inches diameter and 4 inches high), and in its stead a small toy-like affair will require to be introduced, probably achromatic, and finished as carefully as the finest telescope.

613 *bis.*—Spectroscope, W. & H. Skey, Dunedin. This is a modification, and in some respects an improvement, of one of the most ingenious and most delicate philosophical instruments now in the hands of the chemical analyst. The first idea of the Spectroscope appears to have occurred to several independent minds, but it is certainly due to the celebrated chemists Kirchoff and Bunsen to state that they first appear to have fully appreciated its wonderful powers.

Mr. Wm. Swan of Edinburgh (now Professor of Natural Philosophy at the University of St. Andrews,) appears to have first devised the instrument and published a description of it, and he pointed out that its use afforded an infallible test of the presence of sodium, even in the minutest quantities.* At a later period, Kirchoff and Bunsen used a nearly identical instrument (as the figures in the original memoirs show), but it was more delicately made and possessed greater refractive power, and they pushed their investigations much further, and found that by its means the presence, not of sodium only, but of nearly (if not quite) every metal could always be detected, even when present in very minute quantities, by their action on the prismatic spectrum of any flame in which they

* Trans. Royal Soc. Edin., vol. xxi., part 3.

were volatilized and consumed. How far this elegant discovery may be carried it is impossible to hazard a guess; but it is at least possible that nearly every simple substance in nature may be found to have some specific action on light, capable of being at once detected when prismatically analyzed.

But a still more remarkable application of the spectroscope in Kirchoff's hands remains to be described. He first generalized the fact that if the light from an incandescent mass (such as a ball of lime heated to whiteness) is passed through a flame containing the vapors of any metal, the prismatic analysis shows that certain dark lines have been developed which do not exist when the metal is absent. Now it had long been known that numerous dark lines existed in the solar spectrum, and these were with infinite care and labour compared with those resulting from the combustion of various metals, and in many cases were found to coincide, —the inference being that the sun is an incandescent mass surrounded by a gaseous atmosphere in a state of combustion, *in which atmosphere the vapors of many of the terrestrial metals are present.* Thus the presence of iron is well established; calcium, magnesium, sodium, chromium, nickel, barium, copper and zinc, and perhaps cobalt, are also there; but gold, silver, mercury, tin, lead, antimony, aluminium, silicium, strontium, lithium, and cadmium appear to be absent.

This remarkable instrument has thus, in the hands of a philosopher, so far extended the boundaries of human knowledge as to enable us to form more than a guess at the chemical composition of some of the heavenly bodies, thus establishing its claims to be termed one of the greatest triumphs of modern science.

The spectroscope exhibited may be looked upon as a model of an arrangement in some respects novel and good. The absence of gas has necessitated some of the changes, and it has been found that they carry several collateral advantages in their train. The novelties consist in the adoption of a fluid prism of a high dispersive power instead of several solid prisms, the use of a blow-pipe flame necessitating a horizontal arrangement both of the opening or slit and of the refracting prism; an ingenious and simple method of getting a constant blast for the blow-pipe, and other minor alterations. The instrument exhibited is stated to have answered well in the laboratory.

Two Platometers (not in the Catalogue), invented and made by A. Beverley, Dunedin, are very interesting and valuable instruments.

The idea of making an instrument which shall at sight give the area

in square inches or any other unit of any plane figure on a plan, however irregular the outline, after simply running a tracing point round its perimeter, is not new, and several such instruments have been invented. Mr. Sang, C.E., of Kirkaldy, invented and made a very beautiful instrument of this kind, which was exhibited in London in 1851, and which acted very satisfactorily. Instruments on similar principles have been made in France, and Elliott Brothers, the celebrated London instrument makers, have introduced another form. Professor Clarke Maxwell, of Aberdeen, has also published a description of an arrangement devised by him to overcome the theoretical disadvantages of those previously known, which however has not, we believe, ever been made, and which if made would certainly be very expensive. None of these instruments, however, has come into common use, their expense, and perhaps their bulk, having prevented their general adoption. They all (with the exception of Mr. Clarke Maxwell's) have the same common feature of a small divided roller or "count wheel," which rolls upon a plane or conical surface, and can also be slidden along, parallel to its axis, *without revolving* so as to alter the diameter of the path on which it runs; so that in all these instruments the index is made to turn by *rolling motion*, and the *sliding friction* should have no effect on it. While tracing the outline of a figure, however, it often happens that the rolling and sliding motions must go on together, and this has proved to be a source of error, as the sliding friction is apt to interfere with the accuracy of the rolling motion. It was to overcome this difficulty that Mr. Clarke Maxwell devised his platometer, in which spheres in contact are employed, and so arranged as to roll freely on each other in all directions, while the index is only affected by motion in one direction. This is a beautiful idea, and theoretically almost perfect, but the enormous difficulty of producing perfect spheres must always prevent its reduction to practice. Mr. Beverley's Platometer is remarkable for its extreme simplicity, and the consequent low price at which it could be manufactured will in all probability cause it to be commonly adopted. In it the objectionable combination of rolling and sliding is got rid of in the simplest way, by rejecting rolling motion altogether, and making the sliding friction the sole cause of motion in the count wheel.

A light tracing arm is connected with a graduated roller or "count wheel," mounted on a horizontal axis, in such a manner that the arm is virtually a prolongation of the axis of the roller. Were the roller now laid on a plane surface and altogether unconfined in its motion, it could be dragged about by the arm in all directions without ever turning, as the

friction at the point of contact with the plane surface would be always parallel to the axis of the roller. The instrument is, however, guided in such a way that it can only move backwards and forwards in one straight line, while the tracing arm can be moved about in all directions, and at any angle to the line of travel of the roller. When thus arranged, if the tracer be moved on the line of travel, there will be as before no motion of the index, but should it for instance be moved on a line at one side of this line but parallel to it, the axis of the roller will be inclined at a given angle to the line in which it is compelled to travel, and the friction of the plane surface will virtually trace a screw of that angle on the surface of the roller, and compel it to revolve; and the amount of revolution will evidently be proportional to the angle of inclination of the tracing arms (or pitch of the screw), and to the length of line travelled over. Now, suppose the tracer to be run round an irregular figure, the varying breadths of the figure will be represented by the varying pitch or angle of the imaginary screw, while the varying lengths will be measured by the distances that the roller slides backwards or forwards, and thus two quantities—the varying length of the "radius vector," and the angle passed over by it as it varies—are simultaneously represented; and as the area of all figures can be demonstrated to be a function of these two quantities, it is obvious that thus a measure of the superficial area of the figure is obtained. In practice the instrument is found to answer admirably, and to stand the test of a very severe examination. A very great advantage of this form of platometer is that the value of the divisions of its scale varies directly as the length of the tracing arm; thus for small work a short arm may be used, giving a very fine scale, while for less particular work the length of the arm may be made great enough to take in the whole of a large plan at one operation. (It has been found convenient to connect the platometer with a rolling parallel ruler, so as virtually to make the length of the parallel guide unlimited). An adjustible tracer might also be constructed, and properly divided so that the instrument could at once be set to give its result in acres (or any other unit), whatever the scale of the plan on which it was about to be employed. The platometer as thus arranged would not only measure the areas required, but would reduce its results to the required unit, and do away with all need for calculations. This instrument is a most elegant invention, and gives great promise of future usefulness.

Telegraphic Apparatus, exhibited by James Woodford, Agent, Canterbury. 443, an ordinary single-needle instrument of a somewhat antiquated

type, worked by a galvanic battery in the ordinary way. This instrument has been long in use, and has done good service, but we believe it is now almost entirely superseded by instruments which work more rapidly. 442*a*, one of Professor Wheatstone's most recent inventions, and a very elegant Instrument, admirably adapted for Private Telegraphy (for which it is chiefly intended), and for short circuits. It is worked by the magneto-electric currents generated by the revolutions of a permanent magnet, thus rendering a galvanic battery unnecessary; and as the messages are transmitted in ordinary Roman characters, any one can send a message with the greatest facility and without requiring any previous practice. All the arrangements have been very carefully elaborated, and the whole instrument will worthily maintain the reputation of its inventor, and is admirably suited for the purpose for which it was designed.

In the Southland Court is exhibited a Model of a Semaphore designed and exhibited by Thomas Thomson, Harbour Master, Bluff, which appears to have arrived too late to be catalogued and classed, but which appropriately ranks with other telegraphic appliances. Mr. Thomson's semaphore consists of an open square frame of suitable strength and dimensions, in which are pivoted at each end three vertical and three horizontal thin boards, which can be worked in a simple manner by handles so as to present either their edges or their flat sides to the distant station, and thus become practically visible or invisible.

A semaphore resembling the model has been used at the Bluff for some time with complete success, and by it information as to passing ships, &c. is transmitted from the top of the hill to the Electric Telegraph Office in Campbelltown with great ease and rapidity.

The semaphore represented in the model has doubtless been invented by Mr. Thomson, but it closely resembles an old form—indeed the original form—of shutter telegraph, which was long used by the Admiralty, and was superseded in 1816 by the more modern two-arm semaphore. Mr. Thomson's arrangement is however more compact, and probably less liable to mistakes in reading; and as it is besides very simple and easy to make and work, and well suited for a windy locality, the details of its arrangement will repay careful examination.

615.—A number of Surveying Instruments exhibited by J. T. Thomson, C.E., Chief Surveyor, of Otago. These instruments, consisting of a Transit Instrument, a Reflecting Circle and Stand (known as Troughton's Reflecting Circle), a Pillar Sextant, Artificial Horizon, Mountain Thermometer, Level, Small Transit Theodolite, Circumferenter, Station Pointer,

Circular Protractor with verniers, and a Pantograph, are all by the best makers (principally Troughton and Simms), and are of excellent workmanship. Some of them are a little out of date, but the majority are the same as, and equal to, any that are now made. The Reflecting Circle is one of Troughton's best inventions, and is a very valuable instrument; but its weight, which is considerable, has much interfered with its general adoption. Such instruments are now being made of aluminium and its alloys, which combine great lightness with the necessary strength, and the introduction of this metal will probably tend much to increase their use. On the same table Dr. Hector exhibits one of Caselli's "Hygrometers," of an improved form, and one of "Adie's patent Theodolite Levels." This latter instrument is one of a class becoming somewhat common, in which the advantages of two separate instruments are attempted to be combined in one. As the name implies, it can be used either as a theodolite or as a level. When fitted up as exhibited, it possesses the advantages of a transit theodolite of the modern construction, but it is so arranged that the vertical circle and the piers which carry the transit axis of the telescope can be easily removed, and the telescope can be fixed in Ys, which are attached to the horizontal limb, and worked as an ordinary level. The whole of the details of the instrument have been very carefully studied, and are a credit to its inventor, Mr. Adie (of 395, Strand, London), and we consider it to be perhaps the best of its class, and to be well adapted to the requirements of a philosopher, traveller, amateur, or any one who occasionally requires to measure a few angles, or to ascertain a few levels; but the Jury are satisfied that a regular surveyor will prefer to keep the instruments distinct as heretofore. Should it be necessary frequently to alter the "Theodolite Level," from its one form to the other, they are of opinion that the fittings, however carefully constructed originally, will in time work loose, and thus impair the accuracy of all observations which may be made with it.

212.—Telescope, stated to have been manufactured by J. H. Marriott, Wellington. This telescope is of considerable power and gives fair definition, but seems to be scarcely perfectly achromatized.

613.—Mathematical Rulers and Tapes. W. H. Percival, George Street, Dunedin, manufacturer. These tapes and rulers are interesting from their having been manufactured in the Colony, and they are probably sufficiently accurate for the common purposes for which they are intended; there is, however, great room for improvement, there being very obvious irregularities in the length of the divisions in at least some of the examples.

J. M. BALFOUR, Chairman and Reporter.

HONORARY CERTIFICATES.

611. A. BEVERLEY, Dunedin—Ingenious Platometer invented by him—(simple and excellent).

612. THE PROVINCIAL GOVERNMENT, Otago—Cape Saunders Light-house Apparatus.

613. W. & H. SKEY, Dunedin—A Spectroscope.

442*a*. JAMES WOODFORD, Canterbury—Wheatstone's Private Telegraph Apparatus.

1210. T. THOMSON, Bluff Harbour—Improved Semaphore.

612. T. STEVENSON, C.E., Edinburgh—Design of the Cape Saunders Light-house.

612. CHANCE & Co., Birmingham—Apparatus of the Cape Saunders Light-house (manufacturers).

---

*Juror who was also an Exhibitor:**

612. JAMES M. BALFOUR, C.E., Provincial Marine Engineer, Otago.

* If an Exhibitor accepts the office of Juror, no Certificate can be awarded in the Class to which he is appointed, either to himself individually or to the firm in which he may be a partner.—*Decisions on Points relating to the Exhibition*, 11 *(i)*.—ED.

CLASS XIV.

PHOTOGRAPHIC APPARATUS AND PHOTOGRAPHY.

JURORS.

W. M. HODGKINS, *Chairman*. | A. BEVERLEY.

PHOTOGRAPHY, especially the branch devoted to Landscape, occupies a prominent position among the New Zealand exhibits; and it is owing, no doubt, to the magnificent Alpine scenery—the grand picturesque views of mountain, lake, and river—in New Zealand, that the taste of the photographer, as well as the appreciation of photographic art by the public generally, have resulted in so many excellent specimens as are exhibited. On an examination of the numerous specimens of photography which are produced in New Zealand, there can only be one opinion—that some of them fall little, if at all, short of the excellence obtained in the Mother Country. In nearly every department of the Exhibition Building there occur exhibits of this class, which, in addition to reflecting praise on the artists, are invaluable as illustrations of the magnificent character of New Zealand scenery, as well as the variety presented by its animal, mineral, and vegetable kingdoms.

Taking the exhibits in the order of their catalogue numbers, the first is a Case in the Auckland Department, of Views and Portraits by Fairs and Steel (38). Four of them are Groups of Natives, one a Portrait of a Maori Chief, and there are four plates of Landscape Views of North Island scenery. Beyond illustrating what might be termed the home scenery of the Maori population, to the first of these no great merit can be attached in an artistic point of view. The dark landscape views, however, are more than mediocre, but those of lighter tints are hazy and dull, and betray a want of cleanliness in working which would destroy pictures of a far more pretentious character.

A Book, intituled *The Last Cruise of the Wanderer*, by *John Webster*, contains a collection of Photographs of Water-color Sketches, which, while possessing no particular merit as photographs, are useful in indicating a class of book illustration which will be, and no doubt is at this time, extensively used in Europe.

Hawke's Bay.

The Province of Hawke's Bay contributes numerous Photographs, more varied in their subjects than the Auckland exhibits, but, with scarcely an exception, possessing the same fault as those in the Auckland Department.

Wellington.

The photographic exhibits in the Wellington portion of the Building, consisting of three large frames of Views and Portraits, are of a far better class, and do credit to the artist, L. E. Richards (213). The pictures are very clean and sharply defined, and possess all the qualities of good photographs. Among them may be specially mentioned a little picture of "Thorndon Flat," as deserving of great praise for the delicate manipulation and care bestowed on it. The photograph of the "Queen's Wharf" is also very good. Numerous Album Pictures, with portraits of Maoris, possessing equal merit, are amongst the exhibits by Mr. Richards.

214.—Swan & Wrigglesworth's exhibits, although not so good as those of Mr. Richards, are of a far better class than those exhibited by them in the Napier Department, and shew an absence of the fault which pervades the whole of their works in that collection; but, at the same time, in two or three of their pictures, there is an evidence of imperfection in the manipulation of the plate, a dulness, that might have possibly been avoided.

The only other Exhibits consist of Photographs of Wm. Jenkins and family, of Porirua, evidently good portraits.

Nelson.

320.—The pictures by A. Fletcher, of Nelson, are without doubt the finest productions in the Exhibition, and represent some of the most picturesque portions of that picturesque Province. They are four in number, viz.:—

1. The Sources of the Wairoa.
2. The Wairoa Saddle, Dun Mountain Railway.
3. View from the Wairoa Saddle.
4. View looking towards the Dun Mountain.

The wild character of the forest scenery of this part of New Zealand has

been faithfully depicted by Mr. Fletcher in these pictures. A frame of stereoscopic views in this department also deserves great praise for the really excellent manner in which they have been taken. Some of the views are taken apparently by the instantaneous process, and are very successful. Others of them are views of different parts of the town and suburbs, the quays and harbor, and, as a whole, they may be considered to rank as first-class specimens of the photographic art.

Two pictures, presenting a panoramic view of the town of Nelson, and two others of Nelson College, are also very good; as is also a photograph of the Matai Valley.

Canterbury.

In the Canterbury Department are twelve views of the country, by James Elsbee, about Christchurch, which are very good specimens. Among those particularly deserving of notice are "Entrance to the Tunnel, Heachcote Valley;" an "Evening Scene;" "Kowai;" "The Club House and Government Buildings;" also, a "Winter Scene" at Christchurch, and a "Stormy Effect" in Lyttelton Harbour. There is, however, a want of sharpness in some of the other pictures in this frame, which detracts from their otherwise good character as photographs. They are, however, on the whole, exceedingly good specimens of photography, and admirably represent the scenery that surrounds Christchurch and Lyttelton.

Otago.

A most extensive exhibition in the Photographic Department of Art is to be found among the Otago contributions. It comprises views of the City of Dunedin from various prominent stations; Queenstown and the Wakatipu Lake; some of the finest scenery of the interior of the Province; numerous album and other portraits, and photographs of natural objects and productions.

A series of views of the City of Dunedin by W. Meluish, taken at various periods from 1860 to 1865, are pictures possessing great merit. They are exhibited by the Committee of the Dunedin Athenæum (616*a*); by Meluish also, many of the principal streets are admirably photographed.

There is a remarkably good picture also of Dunedin as seen from Cargill Street, executed by M'Gregor and Co. (618). These pictures possess a great value as faithful records of the enormous rapidity with which the City has sprung up, as well as the vast improvements that have taken place in the construction of the most prominent edifices.

The photographs of various public edifices, such as Knox and St. Paul's

Churches, by M'Gregor and Co., as well as that of the Cargill Monument, may be regarded as excellent productions; while to the architect and sculptor they are suggestive of the importance of the photographic art in a professional point of view.

Portrait Photography is very well represented in the Otago Exhibits. Among those calling for special notice, are the portraits taken by the Sennotype process, and exhibited by Peyman & Irving (619); they are really excellent likenesses, and have a softness of tone and general good effect which entitles them to a first place among the portrait contributions to the Exhibition. The collections of *Cartes de Visite* portraits are also excellent specimens of their class.

The Panoramic Views of Queenstown, by Price & Pain (621), exhibit a want of care in manipulating, which has quite destroyed their value as Photographs, although they are faithful representations of the locality. This is to be regretted, as good views of the magnificent scenery in the vicinity of the Wakatipu Lake, would prove very attractive.

The views of various parts of the Province exhibited by Joseph Perry, are, some of them, admirably chosen. The subjects are various portions of the Horse Range; a view of Blueskin Bay; and the town of Hawkesbury. These views have many points of general merit about them, but are on the whole inferior to those recently exhibited by the same artist, consisting of views of the Manuherikia Junction; the Rough Ridge; Oamaru Town and Beach; the Maniototo Plains; and Upper Taieri, the Shag Valley, and Hamilton. These are undoubtedly his best productions, and are the best specimens of Landscape Photography in the Otago Department.

The last and only other photographic contributions calling for notice are some Stereoscopic Views of Queenstown and its vicinity, the Shotover River, Maori Point, and other gold-working localities in that neighborhood, and the Jury would remark that it is very much to be regretted that this, the wildest and most interesting part of the inland scenery of Otago, is so poorly illustrated. Mr. Wright, by whom these views are taken, deserves credit for the pictures he has sent, which, although deficient in some of the conditions necessary to photographic excellence, are nevertheless, allowing for the difficulties under which he must have worked, very good pictures.

South Australia.

2433.—Anson & Francis, Adelaide, contribute some very good small Photographs of various points of interest chiefly taken in the immediate neighbourhood of that City.

Tasmania.

The exhibits by Clifford of Hobart Town (2836), consist of several large views of Hobart Town, &c., and a large number of very excellent Stereoscopic Views of the same locality; among which are some very good pictures of Mount Wellington, Cora Lynn, North and South Esk, Fern Tree Valley, and other objects of interest in that beautiful and picturesque Colony.

In concluding these remarks upon the photographic exhibits in the New Zealand Exhibition, it will be interesting to mark the great value of Photography to every branch of science. It assists the medical science in many forms of disease, the anatomist, the archæologist, the antiquarian, the historian, the virtuoso, in all their widely different researches; the botanist, the geologist, naturalist, architect, engineer, and every other profession, in their various pursuits. These latter remarks are verified by an examination amongst others of the photographs produced from the various fossil and other shells that occur in New Zealand, as well as those of the gigantic Moa and its bones, specimens of which are to be seen in the Geological Department of the Exhibition. In reference to their remarks, in this report, upon some of the inferior photographic exhibits, the Jurors wish to impress upon the exhibitors of those works the absolute necessity of complying with the primary conditions of Photography in care and manipulation in taking pictures; as they feel sure that had those conditions been complied with, the pictures alluded to would have deserved more highly at their hands. The Colony of New Zealand is particularly rich in subjects for the photographic artist, and the Jurors trust that the next New Zealand Exhibition will show specimens of the art, not only superior in quality to some of those now exhibited, but greater in number.

HONORARY CERTIFICATES.

320. A. FLETCHER, Nelson.—Photographs of Nelson Scenery (great artistic and general excellence in landscape and stereoscopic photography.)

619. PETMAN & IRVING, Dunedin.—Photographs (the general excellence of their sennotype and *carte de visite* portraits.)

1088. WM. MELUISH, Dunedin.—Photograph Panoramic Views of Dunedin (a valuable series, showing the progress of Dunedin from 1861 to 1865.)

1087. JOS. PERRY, Dunedin.—Photographs of Otago Scenery (general excellence of his landscape photographs.)

618. JOHN MCGREGOR, Dunedin.—Photographs (general excellence.)

2836. — CLIFFORD, Hobart Town.—Photograph Panoramic View of Hobart Town (also excellence of his stereoscopic views.)

2433. ANSON & FRANCIS, Adelaide.—Photographs of South Australian Scenery (general excellence.)

445*b*. JAMES ELSBEE, Christchurch.—Photographs of Canterbury Scenery (general merit.)

213. E. L. RICHARDS, Wellington.—Photographs of Hawke's Bay Scenery (general excellence.)

214. SWAN & WRIGGLESWORTH, Wellington.—Photographs of Hawke's Bay Scenery (general excellence.)

CLASS XV.

HOROLOGICAL INSTRUMENTS.

JURORS.

J. M. BALFOUR, C.E., *Chairman.*

T. PATERSON, C.E.	A. H. ROSS.
JOHN MILLAR, C.E.	EDWIN JONES.

AMONG the earliest forms of instruments adapted for measuring and recording the lapse of time, sun-dials must certainly have taken a foremost place. In the Middle Ages these were of great importance, from the absence of any other trustworthy time-measurer, and a correct knowledge of the rules on which they were constructed was at a comparatively recent period considered part of the necessary education of an accomplished gentleman. Now, however, sun-dials are generally undervalued, even the common horizontal form being but seldom seen; and we consider this a matter for regret, especially in a country like New Zealand, where the opportunities of ascertaining true time, are in some districts at least, very rare. It ought to be more generally remembered that a well-constructed sun-dial, properly calculated for the latitude of the place where it is to be erected, will give (when its readings are corrected by the use of tables of the "equation of time," which are very simple, and can be, and often are, engraved on the surface of the dial itself,) correct mean time at least to the nearest minute, and often to a smaller fraction if the dial be large. This fact is again becoming more appreciated at home, and it is customary to supply all light-house stations—in Scotland at least—with sun-dials for the express purpose of enabling the keepers to regulate their time-pieces properly, and thus ensure the lamps being lit at the proper hour.

623.—A Sun-dial constructed for the latitude of Dunedin, by Mr. Thomas Glass of Oamaru—the pedestal of Oamaru freestone, and the dial

itself of Italian marble—is a very handsome example of a common horizontal dial, and does Mr. Glass great credit both in its design and execution.

40.—"Curious antique Watch, being one of the first of English manufacture, and originally worn by Oliver Cromwell. A curious sketch of the celebrated Field of Worcester is to be seen on the dial. The watch goes with catgut instead of chain; and was for many years in the British Museum. It was also shown in the Great Exhibition, London, 1862, where it attracted much attention." Exhibited by the proprietor, Thomas A. Fairs, Auckland. This is a very curious and interesting relic, belonging more to History, however, than to modern Horology. In construction it much resembles the old "vertical" watches which even now are not uncommon, and which, though bulky, often keep excellent time. Besides the general rudeness of the works, and the use of catgut instead of chain, it would appear to have had no balance-spring, and to have been regulated simply by the inertia of the balance itself, as was the case with clocks before the invention of the pendulum. This is a corroborative of the antiquity of the relic.

624.—Clock exhibited by J. H. Harris, Dunedin, is a spring clock with a lever escapement, and is simply an enlarged model of the works of a watch if laid on its face and the case removed. It will probably be a very good time-keeper, and the arrangement is neat and well suited for a drawing-room table; the style of finish is not, however, of the very highest class.

625.—Clocks and Watches, exhibited by George Young, Rattray Street, Dunedin. This is a very excellent collection of the regular trade clocks and watches of a high class. The time-pieces in marble cases appear to be of excellent quality. One of the skeleton clocks is especially good, and the other clocks are exceedingly elegant. The watches are of varying quality and price, some being valuable articles and jewelled in many holes; but they present no points of novelty. The collection on the whole is an ornament to the Exhibition, and must have attracted much attention.

Though not an exhibit, the Jurors took the opportunity of examining the Clock in the Tower, which belongs to the Provincial Government, and was made by Messrs. Brysons of Edinburgh, whose name is well known all over the world, and certainly will not be injured by this specimen of their workmanship, as it is well designed in every way, and excellently finished. The escapement is one devised by Mr. Denison and applied to

the Great Westminster Clock, and is peculiarly adapted for turret clocks as being almost entirely independent of any irregularity in the working of the train. If properly levelled, carefully regulated, and kept clean, the Jurors were of opinion that this clock should keep time nearly as well as an ordinary chronometer.

622.—A Side-board Clock, with Compensation Balance and Apparatus to keep it wound up by the variations in temperature and pressure of the atmosphere, invented and made by Arthur Beverley, Dunedin. This time-piece is obviously a very near approach to perpetual motion, as the atmospheric variations appear to be amply sufficient to keep it going until the machinery wears out. It has already been going for many months, and it has never yet failed. The idea of such a time-piece is not new, several having been made on at least similar principles, but they are believed to have proved only partially successful. Mr. Beverley's clock has gone well through all the heat of summer, and now goes on steadily during the winter months, so that there can be now no doubt that it will answer, at least for the climate of Otago. Mr. Beverley's arrangement is very simple, and is the result of a long continued series of experiments, from which he deduced the conclusion that a cubic foot of air properly insulated when at a mean temperature, will by its expansions and contractions exert a power capable of raising a pound weight one foot high in fifteen days. This fact once established, it is clear that if a time-piece could be made delicate enough to be driven by a weight of one pound falling twelve inches in fifteen days, a receiver capable of containing a cubic foot of air will keep the clock going for ever—all the parts being properly arranged; and of course a larger receiver will give more power.

The arrangements of the time-piece exhibited are as follows:—In the base of the case is an air-tight receiver of considerable capacity, which only communicates with the external atmosphere through a tube five inches in diameter, carefully soldered to the upper side of the receiver, and passing very nearly down to the bottom of it. A considerable quantity of oil being poured into the tube, it effectually closes the aperture, and shuts off the enclosed air from all direct communication with the external air, and consequently any variation of the bulk of the air in the receiver, whether from variations of temperature or pressure of the atmosphere, will produce a variation in the level of the oil in the bottom of the cistern, and of course a variation of the level of the oil in the tube corresponding to, but as much greater than, the variation in the cistern as the area of the tube is less than the area of the cistern.

A float rests on the oil in the tube (and rises and falls with it), of sufficient weight to be able in falling to wind up the actual driving weight of the clock. This float acts on the driving weight through the agency of Huyghen's endless chain, the peculiar property of which is, that even when the clock is being wound up, the full force of the driving weight continues to drive the works with unimpaired energy.

The whole arrangement is so proportioned, that according to Mr. Beverley's calculations, a variation of one degree (Fahrenheit) in the temperature of the atmosphere, causes a change of level of the oil in the tube of two-tenths of an inch, and consequently a perceptible motion of the float, and as the diurnal variation in Otago is greatly in excess of that quantity, there must always be sufficient motive power to propel the hands. The other arrangements of the time-piece are characterised by the simplicity and elegance to be observed in all Mr. Beverley's works.

The wheel-work is of the lightest description, and the torsion balance adopted has such a slow motion as to call for a minimum expenditure of motive force.

The arrangements for compensating the balance for variations of the temperature are also very complete : indeed, whether the clock be looked upon as an ingenious application of the motive power inherent in the variations of the temperature and pressure of the atmosphere, or as a very excellent specimen of practical clockmaking, it is worthy of the highest praise ; and if properly regulated and supported free from all vibration, it would in all probability keep very accurate time.

HONORARY CERTIFICATES.

622. Arthur Beverley, Dunedin—For Self-winding Atmospheric Clock, on a very ingenious and original principle.

625. George Young, Dunedin—Excellent assortment of Clocks and Watches.

623. Thomas Glass, Oamaru—A Stone Sun-dial.

CLASS XVI.

MUSICAL INSTRUMENTS.

JURORS.

ALEX. CARRICK, *Chairman.*

C. CALDWELL. | E. FRANCK.

Associate Juror and Reporter: WM. H. HARRISON.

THE study and practice of Music have become so essential a part of education, that Musical Instruments may almost be classed as necessities rather than luxuries. Even in the Colonies a pianoforte is an indispensable object with those who possess the means to purchase one, but the very high cost has limited the possession of them to the wealthier classes. The expenses and risks which attend the importation of pianos, and the difficulty in transporting them over a rough and often roadless country, are circumstances which have almost prohibited their use in isolated or distant settlements, and the want has long been felt of an instrument which, whilst being thoroughly good and serviceable in its parts, shall be at the same time cheap and portable. The Jury noticed with satisfaction that this want has at length been supplied by Chappell and Co. of London, whose "School-room Pianoforte" combines in itself all the points already referred to. This little instrument occupies little more than half the space, and is about half the weight of an ordinary cottage pianoforte. Its interior workmanship is sound and substantial, the essential parts being as complete as is possible in so limited a space. The action, however, might with advantage be simplified so as to reduce the risk of dislocation, and the difficulty of effecting the needful repairs. The case is plain and substantial, and the tone of the instrument is pure and surprisingly full for the shortness of string. Of course there will always be a demand for higher class pianos, and it is worthy of remark that of late years there has been an improvement in the

class of instruments shipped to this Colony. The mistake is still prevalent of regarding a pianoforte more as an article of furniture than on account of its intrinsic merits, and makers have found it more or less necessary to pander to this most erroneous habit. In consequence, a vast number of worthless instruments are turned out in handsome cases, which, when they come into the possession of private owners, become very soon in reality mere pieces of furniture. The spread of musical knowledge and the improvement of public taste is fast working a revolution in the manufacture of pianofortes, and there is an increasing disposition on the part of both manufacturers and their customers to insist upon intrinsic quality.

The Jury would remark upon the really excellent character of the Pianofortes exhibited by English makers, and also upon the very creditable specimen of local manufacture exhibited by Chas. Begg, Dunedin (626). It would be invidious to institute a comparison between this instrument and its English rivals, but as an example of local industry, it is deserving of the highest commendation. Mr. Begg has not aimed at anything extravagant, but simply to produce a sound well-constructed instrument, and he has succeeded in a degree certainly not previously attained by any colonial manufacturer. With the exception of the metal-work, the whole of the parts were constructed by the Exhibitor. The case is of the Red pine (Rimu) of Otago, and the string board and sounding board are of Swiss pine. The action is a simple one, in fact Broadwood's action, and the workmanship throughout is very creditable indeed. Broadwood & Sons (2940), are represented by two excellent Pianofortes—a Grand, exhibited by Mr. West of Dunedin, and a Cottage shown by Mr. Begg (627). Of these instruments, particularly the Grand, the Jury have nothing further to say than that they fully sustain the reputation of the makers. Collard & Collard's Pianos have long occupied a foremost rank, and their superiority is exemplified in a Cottage Pianoforte, exhibited by Mr. Begg, of Dunedin. For purity, equality, and roundness of tone, freeness of action, and general excellence, this instrument was not exceeded by anything in the Exhibition.

Messrs. Chappell & Co., in addition to the small School-room Pianoforte already referred to, have contributed two other models, the "English Model," and an "Oblique Grand." This last named instrument is in every respect of a very superior character. It has three strings, and seven octaves, A to A. It is strengthened by every possible means to endure the greatest amount of wear, and to resist the action of variable climate. The workmanship is of the best description, the tone is round, full, and

rich, and of great power. The touch is elastic, and the repetition very rapid. This instrument is peculiarly well adapted for concert-rooms, musical societies, &c., where great power is required. The English model is a fair medium character of instrument, which is sold at a moderate price.

The only Harmoniums shown in the Exhibition were exhibited by Messrs. Chappell & Co., through their agent Mr. G. J. Brown, of Dunedin. These comprised two of Alexandre's celebrated make, and one of the exhibitors', own manufacture. The Alexandre Harmoniums are of undoubted excellence; the "Drawing-room Model" with percussion action and knee swell, is well adapted for domestic use, the tone being soft and sweet, and at the same time the power can be increased at will by the use of the knee swell. The other Harmonium by Alexandre, which is designated by the Exhibitors the "Queen's Model," is a most beautiful instrument, rich and full in tone, and displaying unusual care in the workmanship of the several parts. The Exhibition "Model Harmonium" in carved Gothic case, is one of the best of its class, and is admirably suited for use in small churches or chapels. It contains eleven stops, viz., five in the bass, and five in the treble, and the expression stop. The whole of the reeds are enclosed in a Venetian swell, worked by the heel of the right foot. Two modes of expression are obtained—viz., by pressure on the swell pedal, or when the expression stop is drawn, by the variation of pressure on the foot-boards.

Messrs. Chappell also exhibit a very useful and ingenious apparatus for the guidance of amateurs in tuning pianofortes. It consists of a small accordion-like appliance, with a complete scale of notes tuned to Broadwood's pitch. The instrument can be readily fixed to the front lip of the pianoforte, and by the upward pressure of the knee, and pressing down a key which remains down until no longer required, a prolonged note is sounded, to which the strings of the piano can be tuned in the usual manner. This is an undoubtedly useful apparatus for amateurs, to whom the tuning of a pianoforte is a difficult task. It was invented by Mr. R. A. Kemp.

The only Organ in the Exhibition is one built in the Colony, by E. W. Jones of Wellington, and exhibited by E. Lewis (215). It originally stood in the Odd-Fellows' Hall at Wellington, since when it has undergone some alterations. The mechanical parts and some portion of the wooden pipes were alone made in the Colony, the metal work being English made. The Organ comprises nine stops—viz., Open and Stop Dia-

pason, Bourdon, Cremona, Flute, Principal, Fifteenth, Hautboy, and an octave and a-half of pedal pipes. The quality of the diapasons is good, the principal is a creditable stop, and the same may be said of the Cremona. The Organ was however, absolutely out of tune, and the bellows were fractured in several places, so that a fair test of the quality of the instrument could not be obtained.

A fine old Cremona Violin (630) was exhibited by J. Reid Mackenzie, Dunedin.

E. Gielenfeldt, of Dunedin, also exhibited a Zitter (628).

In 1862 the value of the musical instruments, chiefly pianofortes, imported iito New Zealand was £13,485; and in 1863 more than £20,000.

HONORARY CERTIFICATES.

2940. BROADWOOD & SONS, London—Grand Boudoir Pianoforte.

626. COLLARD & COLLARD, London—Cottage Pianoforte, exhibited by Charles Begg.

——. CHAPPELL & Co., London—Useful School-room Pianoforte (on the ground of its great adaptability for Colonial use, and its cheapness); and Harmoniums.

CLASS XVII.

SURGICAL INSTRUMENTS.

THIS Class was only represented by a Truss for Prolapsus, exhibited by T. W. Tatton, Nelson (322), not possessing any novelty; and a few Stethoscopes, of wood, exhibited by T. M. Wilkinson, Dunedin (518), and others of Ebonite, by the India Rubber, Gutta Percha, and Telegraph Works Company, Limited (2942). All these Stethoscopes were of the most approved forms in common use.

Enemas, Pessaries, Caustic Holders, Ear Trumpets, Syringes, and Injection Bottles of India Rubber and Ebonite were also exhibited by the India Rubber, &c., Works Company (2942), of various useful kinds.

CLASS XVIII.

COTTON MANUFACTURES.

JURORS.

JOHN ALEXANDER EWEN, *Chairman.*

JOHN BUTTERWORTH. | THOS. CHAS. SKINNER.

THE manufactured goods in this Class are exhibited by English manufacturers, who have contributed specimens of their various productions.

2943.—Clark & Co., Paisley, exhibit a case of specimens of their Sewing and Crochet Cotton Thread. The samples fully sustain the reputation of this firm for articles of this description. An Honorary Certificate was without hesitation recommended for these exhibits.

2944.—George Frazer, Son, & Co., Manchester, send samples of Cotton Fabrics, the value of which is increased by the fact that prices are affixed to each pattern. The Jury unanimously recommended an Honorary Certificate for these exhibits.

2945.—Daniel Lee & Co., Manchester, exhibit samples of Dress and Furniture Prints, the patterns of which, however, are totally unsuited to the New Zealand market, being for the most part glaring in design and color, only suited for a Native trade with Africa or India. Some of the samples might possibly do for the Maori trade, but even then only at a price much lower than that quoted.

2946.—Ashton Brothers, Manchester, Samples of Grey and White Calicos.

2947.—S. Schwabe, Manchester, samples of Prints, open to the same objections, in a modified degree, as those applied to the specimens exhibited by Lee & Co.

2948.—A. S. Henry & Co., Manchester, samples of Velvets, Moleskins, and Cords.

The Jurors desire to express the opinion that the Exhibitors of Printed Goods have held a mistaken idea of the requirements of the New Zealand market. No doubt the Exhibition will have the good result of removing this misconception, and of thereby drawing attention to the class of goods appropriate to the trade.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

2943. CLARK & Co., Paisley.—Sewing and Crochet Cotton Threads.

2944. G. FRAZER, SON, & Co., Manchester.—Grey and Bleached Calicos, of good quality.

CLASS XIX.

MANUFACTURES OF FLAX AND HEMP.

JURORS.

J. A. EWEN, *Chairman.*

T. C. SKINNER. | J. BUTTERWORTH.

THE Exhibits in this Class are exceedingly limited in number and variety.

247.—William Davies, Otaki, Wellington, exhibits a Coil (fifteen fathoms) of small Rope, and a quantity of Clothes Lines, made from the fibre of the *Phormium tenax*. The ropes are carefully and evenly spun and laid, and are quite equal to anything of the kind imported, and in the opinion of the Jury deserve an Honorary Certificate.

1211.—J. Scott, Invercargill, exhibits samples of Twine for grocers and other purposes, made from the fibre of the *Phormium tenax*. The article is highly creditable in every respect, and well merits an Honorary Certificate.

635.—Titley, Tathams, & Walker, Leeds, exhibit through their agent A. Walker, Dunedin, a case of samples of Shoe-thread, manufactured by that eminent firm. Shoe-thread is a loosely spun thread, made from the strongest and largest descriptions of flax, and is used for stitching purposes by shoemakers and saddlers. Messrs. Titley, Tathams, and Walker obtained medals at both the great Exhibitions in London for the superior quality of their shoe-threads, and the Jury without hesitation recommended an Honorary Certificate to be awarded them.

2949.—W. and N. Lockhart, Kirkcaldy, exhibit a Fishing Net fifty-five yards long, three hundred meshes deep, of excellent make. Messrs. R. B. Martin & Co. are the agents of the manufacturers in Dunedin.

216.—J. G. Holdsworth, Wellington, shows a Hat made of the fibrous inner bark of some tree unmentioned, but probably *Hoheria populnea*, a species of "Ribbon Wood." The hat is ingeniously plaited, and exhibits a great deal of pains on the part of the maker.

445.—The specimens of Prepared Pulp for manufacturing into paper, exhibited by Robt. Cameron, Christchurch, have been referred to in the report under Section I., Class IV., pages 118, 121, 132, as in their incomplete stage of manufacture they appeared to come more strictly under the designation of "raw material."

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

247. WM. DAVIES, Wellington.—Excellent Rope made from New Zealand Flax

635. A. WALKER, Dunedin (as agent for Titley, Tathams, and Walker).—Shoe-threads of superior quality.

1211. J. SCOTT, Invercargill.—Excellent Twine from New Zealand Flax.

2949.—W. & N. LOCKHART, Kirkcaldy.—Fishing Nets of excellent make and material.

CLASS XX.

SILK AND VELVET.

JURORS.

J. A. EWEN. | T. C. SKINNER.
J. BUTTERWORTH.

THOMAS KIRK, Newton, Auckland (42), exhibits a number of specimens of Silk Weaving which are a novelty in this branch of manufacture. They are the production of an ingenious manufacturer in Coventry, (Mr. Stevens,) and consist of a variety of "Illuminated" Book Markers, containing designs appropriate to religious or secular purposes. Some have woven in them excellently executed portraits of eminent men, such as Byron, Shakespeare, Bunyan, Garibaldi, Luther, &c., &c. Those adapted for Prayer-books are inscribed with various portions of the Church Ritual in richly illuminated characters.

W. H. HARRISON, Reporter.

CLASS XXI.

WOOLLEN, WORSTED, AND MIXED FABRICS GENERALLY.

JURORS.

J. A. EWEN. | J. BUTTERWORTH.
T. C. SKINNER.

SPECIAL interest attaches to this Department, on account of the exhibits of Woollen Goods manufactured in New Zealand and Australia. It is somewhat surprising that, seeing the production of wool is one of the most extensive and important branches of Colonial industry, scarcely any attempt has been made to manufacture some of the plain and ordinary descriptions of woollen goods, the consumption of which is extensive, and which are imported at a cost much exceeding the price at which they could be produced in the Colony. The number of charges in the shape of freight, insurance, duty, and the intermediate profits of the manufacturer, shipper, and importer, which the wool has to bear from its leaving the Colony to its return in the Colonial market in the form of cloth, should leave an ample margin for the increased cost of manufacture in the Colony. The price of labor here is, of course, greatly in excess of the Home rate, but not so much as to be prohibitory of the manufacture of many ordinary fabrics. Australia, and particularly New South Wales, is most favorably circumstanced for the production of woollen cloth by steam machinery, on account of the plentiful and cheap supply of coal, and the greater abundance and lower rate of labor, as compared with New Zealand. These advantages have not wholly been neglected, as the really excellent and numerous exhibits by Mr. E. O. Ebsworth, of Sydney, sufficiently prove. The manufacture of woollen cloth in New Zealand is at present carried on only at Nelson, by Mr. Joseph Webbley, who exhibits some very creditable specimens of his production. The advantages of

cheaper labor and coal supply in New South Wales are nearly equalled by the exhaustless supply of water-power that is to be found all over New Zealand; and it would appear that the importation of the necessary machinery is almost all that is requisite to establish many branches of manufacture, for which an abundant supply of raw material exists in the Colony. So far the attempts in the woollen manufacture have been confined to the production of plain, or simple varieties of fancy trouserings, flannels, and tweeds. But almost any kind of fabric, not involving skilled labor, or costly processes of finishing, &c., could be manufactured with advantage. The manufacture of blankets appears particularly to recommend itself to attention, as being a branch requiring the simplest machinery and the least skilled labor. And although the wool ordinarily used in England for this purpose is not grown extensively in New Zealand or Australia, almost any description of common wool could be worked, and it is the opinion of persons experienced in the woollen manufacture, that, it would pay far better to use up in this way the common low kinds of wool, which, when exported, fetch so low a price at Home.

In their examination of woollen fabrics exhibited by Colonial Manufacturers, the Jury did not expect to find, nor did they look for, those points of excellence in finish, design, &c., which can only be produced by means of the costly machines, skilled labor, and scientific appliances and advantages possessed by English manufacturers. They were the more surprised, therefore, at the very creditable results in these particulars presented by the specimens before them. In the general points of manufacture the goods of Mr. Ebsworth are not surpassed by any of the English exhibits, whilst in suitability for Colonial wear, durability, and other essential particulars, they are equally excellent. The cloths manufactured at Nelson, by Mr. Webbley, are a heavy, thick description of tweed, of first-rate quality for wear

New Zealand.

321.—J. Webbley, Nelson, exhibits sample pieces of heavy Tweed of his manufacture, of which the Jury desire to speak in the highest terms of praise, and they without hesitation recommend the award of an Honorary Certificate, on the ground of the excellence of manufacture and suitability of the goods for Colonial wear. They regretted that no quotations of prices were affixed to these cloths, an oversight of considerable importance to the manufacturer. A case of specimens (313), illustrative of the various stages of the woollen manufacture added much to the interest of the exhibits.

637.—Ross & Glendining, Dunedin. The collection of Woollen Goods exhibited by this firm is of the highest merit, equally as regards quality, design, variety, and suitability to the trade. A striking feature of this collection is a series of Scotch Woollen Tartans, manufactured specially for the exhibitors, the beauty and quality of which could not be excelled. Although only exhibiting as Importers, the Jury feel justified in recommending the award of an Honorary Certificate to Messrs. Ross and Glendining, for the excellent judgment displayed in the selection of their goods, and for the first-class character of the articles exhibited.

New South Wales.

The exhibits by E. O. Ebsworth, of Sydney (2408), included Tweeds; undyed, from New Zealand skin and New South Wales black wools; from New Zealand and Queensland fleece wools; from New Zealand and New South Wales fleece wools; from New South Wales fleece wools; from New South Wales and Queensland fleece wools; from New South Wales and Victoria fleece wools; and from New South Wales, Victoria, and Queensland fleece wools; and Swanskin from New South Wales fleece wools.

The Jury regretted that no quotations of prices accompanied these samples, as it would have enabled them and the public to institute a comparison with imported goods in this respect. The award of an Honorary Certificate was unanimously agreed to be recommended for the excellence and suitability of these goods.

Great Britain.

Great Britain was represented by eight Exhibitors of the various varieties of Woollen, Worsted, and Mixed Fabrics. The interest of some of the specimens was increased by the fact that they were manufactured from New Zealand wool. Special value also attached to the various specimens exhibited by Messrs. John Foster & Son, Bradford, illustrating the Mohair and Alpaca manufacture. The samples generally represented almost every variety of woollen and worsted goods of the most recent designs, and were a source of considerable interest to visitors in the Trade.

The following is a list of the Exhibitors.

2952.—Bull & Wilson, St. Martin's Lane, London, send patterns of various fabrics for Coats, Trousers, and Waistcoats. These are all of the very first quality and design, and fully illustrate the perfection to which the manufacture of fancy and mixed fabrics has been carried.

2953.—Joseph Craven, Bradford, exhibits Shawls and Dress Goods

made from New Zealand wool, "showing what can be made of this material." The variety of these goods illustrates the useful properties of the New Zealand wools in a remarkable degree, whilst of their quality and other points no more need be said than that they are of the highest order of merit.

2954.—Edwin Firth & Sons, Heckmondwicke, near Leeds, send a number of White and Colored Blankets of first-class quality, to which prices are attached.

2956.—Schwann, Kell, & Co., Bradford, exhibit Patterns of thirty-one varieties of Plain and Tinted Merinos, Coburgs, Mohairs, and Alpaca Lustres, Italian Cloths, &c.

2957.—Edmund Bell & Co., Bradford, furnish specimens of Black Coburgs and Baratheas.

2958.—Joseph Craven, Bradford, sends samples of Mousselines de Laine, Merinos d'Ecosse, Cashmere d'Ecosse, Repp, Cordes de Repp, Diagonals (various colors), Melange (various colors), Llamas (various colors), all wool: Coburgs, Victoria Cord, Coburgs for Shawls and Cloaks, Victorettas, Paramattas, Henriettas, Baratheas, Double and Single Twills, Indiana Shawls and Scarfs, and Thibet Cloth, all made with cotton warp and woollen weft. Shawls, Cloak Cloths, Mantle Cloths, all wool. This collection deserves special mention, both as to its illustrative variety, and for the excellence shown in all points of manufacture.

2959.—John Foster & Son, Bradford, exhibit a series of Specimens illustrating the Mohair and Alpaca Manufacture, viz.:—

1. Mohair or Goat's Wool, grown in Angora, Asia Minor. The silky hair of this goat, which hangs in long curls, is invariably white, the average length of the staple being five to six inches. The fleece is called locally "Tiftik.' When clipped annually in April or May, they yield from 1½ to 4 lbs. of wool or hair, according to age. The demand for this wool is only of recent origin. In 1848, mixtures of this wool with alpaca, silk, cotton, and worsted, came into use for ladies' dresses, and for a heavy material known by the name of "flushing," for gentlemen's overcoats, in which article the goat's wool was thrown to the surface, so as to resemble to some extent the original fleece, except in color. The principal consumption of mohair now, is for mixing with other animal fabrics for ladies' dresses, lustres, umbrellas, &c. Mohair is perfectly free from "underdown," unlike the Thibet or Cashmere fleece, which has a downy covering on the felt, with long coarse hair or "kemps" at the top,

the separation of which is tedious and expensive. In sorting mohair, about one-sixth part is taken out, which is too short in the staple and not applicable for combing purposes, and in the process of combing about one-fifth part is made into "noils;" these together are bought by woollen manufacturers for making into cloth of different kinds, and other materials.

2. Alpaca Wool, black, brown, fawn, and grey.

3. Combed Mohair Tops, in three qualities.

4. Mohair Noils.

5. Combed Alpaca Tops, in medium quality, of various colors.

6. Combed Alpaca, in fine quality, white and grey "Tops," and the long fibres separated by the combing machine, and fit for spinning into yarn.

7. Alpaca Noils. Noils are the short fibres and knots left after combing.

8. Yarns, of Mohair and Alpaca, of different qualities, and paper tubes containing Weft, as exported ready for the weaver's use.

9. Finished Goods—mohair, alpaca lustres, &c., and an interesting specimen of violet and white mohair leno, from a dress selected by the Bradford Committee for presentation to the Princess Alexandra on her marriage, March 8th, 1863; a very beautiful specimen of their manufactures. This collection is extremely interesting, and well illustrates the process of manufacture of Mohair, Alpaca, &c. goods. It was recommended for an Honorary Certificate.

2913.—Stansfield, Brown, & Co., Bradford, send a variety of Samples of Stuff Goods of excellent quality.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

321. JOSEPH WEBBLEY, Nelson.—For excellence of Woollen Cloths.

637. ROSS & GLENDINING, Dunedin.—Excellent Woollen Goods.

2408. O. B. EBSWORTH, Sydney.—Woollen Cloths of general excellence.

2952. BULL & WILSON, London.—Trousering and Vesting of excellent quality and design.

2958. JOSEPH CRAVEN, Bradford.—Shawls and Dress Goods of New Zealand Wools—excellence of manufacture.

2954. EDWIN FIRTH & SONS, Heckmondwicke.—Blankets of superior quality.

2956. SCHWANN, KELL, & Co., Bradford.—Coburgs, Alpacas, Lustres, &c.

2957. EDMUND BELL, & Co., Bradford.—Baratheas.

2913. STANSFIELD, BROWN, & Co., Bradford.—Union Lastings.

2959. JOHN FOSTER & SON, Bradford.—Excellent Illustrations of Mohair and Alpaca Manufactures.

CLASS XXII.

CARPETS.

JURORS.

J. A. EWEN. | J. BUTTERWORTH.
T. O. SKINNER.

THIS Class is represented by a collection of samples exhibited by the eminent manufacturers John Crossley & Sons, of Halifax, and by a large carpet manufactured for and exhibited by Herbert, Haynes & Co., of Dunedin. In no branch of manufacture has greater advance been made than that of carpets, within the last few years. The improvements in taste, color, and design are remarkable, and by means of steam-machinery and unremitting mechanical skill, the cost of production has been materially cheapened. Carpets are not now the costly luxury they used formerly to be, and as the natural consequence of the cheaper production of the article, they are to be found in every dwelling. John Crossley & Sons have done more than any other manufacturers to improve carpet manufactures, chiefly by means of their various patented inventions in machinery. Fourteen years ago the application of steam-power weaving to tapestry carpets had been found so successful, that the patentees, John Crossley & Sons, turned their attention to the manufacture of Brussels carpets by similar means, and they succeeded in producing a power-loom for jacquard carpet-weaving, able to turn out forty yards per day, being five or six times as much as an ordinary hand-loom could produce in the same period.

2960.—Crossley & Sons exhibit a number of Patterns, which, as samples of the quality of their goods, thoroughly answer their purpose, but the Jury were disappointed at the meagre display of good designs. As a collection, Messrs. Crossley's specimen did not do proper justice to the world-wide reputation of the firm.

638.—Herbert, Haynes & Co., Dunedin, as the Importers, exhibit a large Memorial Carpet, of the description known as Axminster. It is one of three manufactured at great cost by Thomas Taplin & Co., London, and is a

wonderful and gorgeous specimen of the art of weaving. It is an imitation of the Gobelins Tapestry, and is intended more for hanging as tapestry, than for an ordinary carpet. In the centre are full length figures of Queen Victoria and the Emperor Napoleon, standing. The Emperor is represented in the act of presenting to Her Majesty a copy of the Treaty of Commerce, the words "The Treaty of Commerce, a further proof of our Friendship," being inscribed on the scroll. Underneath is a scroll bearing the motto "*La Reciprocité est la base vraie et durable de la paix.*" On the lower corners are medallions, the one containing the Imperial cipher N, and the other the letter V. The standards of England and France, groups of roses and fruit, and an architectural border, complete what is in every respect a wonderful combination of art and mechanical skill. The carpet was hung over the principal entrance to the Building, and was a prominent ornament to the Exhibition. The Jury for this exhibit recommended an Honorary Certificate.

In the collection of objects contributed by Dr. Lauder Lindsay, are some small samples of "Dutch Carpet," manufactured from jute, by a firm in Dundee. Jute takes a brilliant dye, and when woven into carpets closely resembles wool in appearance. The extremely low price at which these Jute, or "Hemp" carpets as they are sometimes called, can be produced, has brought them into considerable use amongst the poorer classes, and large quantities are exported.

WOOL MATS.

Although catalogued in Class 30, it was considered by the Jury that the Dyed Wool Mats exhibited by John Switzer, Dunedin (1008), should occupy a place in this report. Though not by any means a novelty, still there are many points in which these mats are greatly superior to the dyed sheepskins ordinarily used. The great points to be observed in the preparation of these mats, are, first, the absolute curing of the skin; second, the preservation of the staple of the wool; third, color and design. The mats exhibited by Mr. Switzer are most excellent in every respect. The skins are absolutely cured, and the preservation of the gloss and staple of the wool is a striking feature. As to color and pattern, the specimens are brilliant and tasteful; and the Jury unanimously recommended an Honorary Certificate for these exhibits.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

638. HERBERT, HAYNES, & Co., Dunedin.—For a Carpet.
1008. JOHN SWITZER, Dunedin.—Superior excellence of Dyed Wool Mats.

CLASS XXIII.

WOVEN, SPUN, FELTED, AND LAID FABRICS, WHEN SHOWN AS SPECIMENS OF PRINTING OR DYEING.

JURORS.

J. A. EWEN | J. BUTTERWORTH.
T. C. SKINNER.

SO far as the Colony is concerned, the dyeing of materials is almost entirely confined to the re-dyeing of articles of Dress and Upholstery; a most useful art, for there are many kinds of material that lose their color before the texture is half worn. G. Hirsch, of Dunedin (639), exhibits a case of specimens of Dyed Wools, Silks and Feathers, and Dyed Sheepskins. The colors on the whole are very fair, and reflect considerable credit on the Exhibitor, to whom the Jurors recommended an Honorary Certificate should be awarded.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATE.

639. GUS. HIRSCH, Dunedin.—For specimens of Dyeing in Silk, Feathers, &c.

CLASS XXIV.

TAPESTRY, LACE, AND EMBROIDERY.

JURORS.

J. A. EWEN. | J. BUTTERWORTH.

T. C. SKINNER.

Auckland.

W. SPURGEON (43), exhibits a Patchwork Quilt, the work of Chas. Spurgeon, 65th Regiment. It is composed of numberless pieces of red, white, and black cloth, from cast-off military clothing, and is an example of patient manipulation and some ingenuity.

44.—Miss Ellen Sommerville, Auckland, contributes a Vase of Paper Flowers, which are made and arranged tastefully. They reflect great credit on the producer. This exhibit scarcely comes strictly under this Class, but the Jury decided to notice it under this heading.

Wellington.

218.—Miss Mary Ann Woodward exhibits two Footstools covered with Berlin Wool Work, of her production. The design and execution of the work, and the careful choosing of appropriate colors which is manifested, invest the specimens with a high degree of merit.

228.—Miss Ellen Reading shows a Counterpane neatly executed in Crochet Work.

Otago.

640.—Mrs. S. Cohen, Dunedin, contributes a finely executed Piece of Tapestry Work, representing the "Finding of Moses." The choice of colors has been carefully regulated, and the whole production is highly creditable. The frame of this specimen is worthy of notice, as a sample of good wood-carving, executed by Messrs. Cohen Brothers.

641.—John Lazar, Dunedin, exhibits a beautifully wrought Fire Screen, in wool, silk, and beads.

642.—Mrs. Merry, Dunedin, contributes a Specimen of Tapestry Work, being a large representation of "Christ Walking on the Water." It is well executed.

643.—Mrs. Gribbon exhibits two pieces of Tapestry Work, the subjects being "A Figure of Our Saviour," and the other "The Entry into Jerusalem." The latter deserves very high praise.

Two Chairs, exhibited by Mr. John Hill, of Dunedin, in Class XXX., as "Furniture," deserve mention in this notice for the beauty of their Embroidery. Had these examples been entered for exhibition, the Jury would unhesitatingly have recommended an award in their favor. In the absence of any information, however, they did not feel warranted in doing so.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

44. MISS E. SOMMERVILLE, Auckland.—Paper Flowers.
640. MRS. COHEN, Dunedin.—Tapestry Work.
642. MRS. MERRY, Dunedin.—Tapestry Work.
218. MISS MARY ANNE WOODWARD, Wellington.—Tapestry Work.

CLASS XXV.

Sub-Class A.—SKINS AND FURS.

JURORS.

J. A. EWEN | J. BUTTERWORTH.
T. C. SKINNER.

NEW ZEALAND is almost devoid of animals valuable for their skins or furs. The Maoris used formerly to attach great value to the skins of some of the indigenous birds, which were worn as mantles. The Kiwi was especially esteemed for this purpose, and the skins of dogs were similarly employed. At one time various parts of the Coast abounded with seals, especially the West Coast of the Middle Island; where the occupation of sealing is still followed by a few adventurous persons, both Native and European. The skin of the seal is valuable for many purposes, but, as an article of export, sealskins scarcely find place in the trade of the Colony.

The Exhibits in this Class were as follows :—

146.—The Local Committee of Hawke's Bay send a Sealskin Haversack, made from the skin of an animal killed and dressed by a Wairoa Maori.

644.—P. C. Allardyce, Port Chalmers, exhibits a fine Bear skin of a large Polar bear, killed by the Exhibitor.

645.—The Waikouaiti District Committee exhibit a Sealskin from an animal killed on the coast in that neighbourhood.

Sub-Class B.—FEATHERS, AND MANUFACTURES FROM HAIR.

2963.—Thomas Richard Condron, London, exhibits a number of samples of Brushes, of excellent quality and manufacture, recommended for an Honorary Certificate.

There are no Colonial Exhibits in this Sub-Class.*

W. H. Harrison, Reporter.

HONORARY CERTIFICATE.

2963. T. R. Condron, London.—Brushes of superior quality.

* For Wigs, see Class XXX.—Ed.

CLASS XXVI.

LEATHER, INCLUDING SADDLERY AND HARNESS.

JURORS.

SYDNEY JAMES, *Chairman.*

A. McFARLAND.	JNO. McLEAN.

Associate Jurors:—

JOHN SWITZER.	JAMES HATCH.

SUB-CLASS A.—LEATHER AND MANUFACTURES MADE OF LEATHER.

IN order that full justice should be done in the examination of the various descriptions of leather shown by exhibitors, it was decided by the Jurors to call in the assistance of the gentlemen whose names appear as Associate Jurors, whose practical knowledge and experience enabled them to form an accurate opinion of the descriptions of leather used in the manufacture of boots and shoes. The Jurors accordingly adopted the report of the Associate Jurors in reference to Boot and Shoe Leathers, confining their own attention chiefly to the consideration of Saddlery, Harness and Leather for the same.

The Jurors desire to place on record, their regret that in no single instance have the instructions to Local Committees or exhibitors, with respect to leather, been complied with. The Commissioners desired exhibitors to "state the materials used in tanning or otherwise preparing it, and the animal whence the skin was obtained; the principal qualities and uses of the particular leather; and price." The omission of these particulars was the more important, as in one particular instance leather is exhibited as being "tanned with New Zealand barks," but the description of bark is not mentioned. Again, the leather exhibited in the Nelson Department, is unaccompanied by any particulars excepting price, and the

Jurors the more regretted this, inasmuch as the leather in question was exceedingly well tanned, and free from many defects which were manifest in the Auckland goods. The personal knowledge of the Jurors enabled them to supply the omission of particulars with respect to the Otago exhibits, and likewise to those from the neighbouring Colonies.

The desirability of developing the productive resources of the Colony, and of introducing those branches of manufacturing industry the materials necessary for which can be produced in New Zealand, cannot be questioned. This can only be accomplished by steady perseverance, and by the spread of information. The importance of the trade in leather and manufactures therefrom, as far as New Zealand is concerned, may be seen by the following statistics :—

IMPORTS OF LEATHER, SADDLERY AND HARNESS, AND BOOTS AND SHOES.

	Leather.	Saddlery, &c.	Boots and Shoes.
1860	£7,603	£21,168	£39,929
1861	10,844	29,635	89,223
1862	21,719	51,023	177,531
1863*	25,601	68,595	209,693

Making a grand total expenditure during the four years on leather and leather manufactures of £516,376. During the same period the Exports of hides, skins, and bark were in value as follows :—

	Hides.	Skins.	Bark.
1860	£4743	£2855	3 tons.
1861	4893	2883	30 tons.
1862	5869	4349	20 tons.
1863	8341	4171	20 tons.
1864	11,972	5296	31¼ tons.

The barks† generally used, where New Zealand barks are employed by the tanners, are the white and black birch, but no doubt there are others which possess valuable tanning properties.‡ As yet, however, the principal tanners use imported bark from Australia. Generally speaking, the tanning of the leather exhibited by Colonial producers is excellent, and in some instances is of the highest character ; but with regard to the

* Return for 1864 not yet published.—ED.

† With respect to "Tanning Materials" the following information was requested by the Commissioners :—"All New Zealand or other tanning materials when of vegetable origin, should be accompanied by a short description of the tree, &c. from which the material is obtained, together with dried specimens of the leaves, flowers, and fruit ; the manner in which the material is obtained and used, and its scarcity or abundance ; and whether an article of present commerce, and to what extent ; its price, &c."—ED.

‡ See Art. Tanning, Supplementary Report on Class I., Appendix A.—ED.

currying of the leather, there is not only a marked difference between the various exhibitors, but great room for improvement in particular cases. On the whole, however, the Jury had great reason to be satisfied with the character of the goods exhibited, and are of opinion that with the requisite attention to the matter of currying, the New Zealand manufacturers will be able to produce leather quite equal to the requirements of the trade.

The attempts hitherto made by Colonial manufacturers in the preparation of pigskins for saddlers' purposes, have not been successful, and the pigskins exhibited are very inferior. The Jury also found that the calfskins were not so sound as the same description of leather produced by English tanners.

The exhibitors of Leather numbered seven—viz., one from Auckland, one from Nelson, two from Dunedin, one from Sydney, one from Victoria, and one from Tasmania.

Auckland.

Ireland Brothers, (46), exhibit samples of Sole Leather, Black and Brown Harness Leather, Bridle Harness Leather, Waxed Calfskins, Kips, Grained Kips, Grained Calfskins, Bag Leather, and Hogskin. These specimens are stated to have been tanned with New Zealand bark; but, as no further information was given, the Jury could express no opinion, further than that the leather was well tanned. Generally speaking, these specimens were deficient in their subsequent preparation after leaving the tanner. The exhibitors also show a six-inch Double Mill Belt of good make and quality.

Nelson.

Sedgwick & Gowland, Nelson (323), exhibit twelve samples of leather of various descriptions, including Black Leather, Brown do., Bag Hide, White Butt for Mill Straps, Kip, Cordovan, Calfskin, Goatskin, Hogskin, Bridle Butt, Kip, Back, and one Brown Sheepskin Mat. These specimens were accompanied with a list of prices, which enabled the Jury to institute a comparison with imported leather; the result being that the prices quoted are a fair marketable value of the goods. The Jurors considered the leathers exhibited to be very creditable specimens, showing great care and judgment in the various branches of manufacture. They would especially mention the Kip, and Cordovan, as being exceedingly good, and they unanimously recommended an Honorary Certificate for these goods.

Otago.

William Bridgeman, Caversham Tannery, Dunedin (646), exhibits a large collection of samples of the various descriptions of Leather, used by

saddlers, harness makers, and boot and shoe manufacturers. In this instance no mention is made of prices, or of the materials used in tanning, but it is known to the Jury that Australian bark was employed by the exhibitor. The Jury unanimously agreed that the leathers shown by this exhibitor were the best in the Exhibition; the tanning and currying very superior, and a better class of goods generally could not be desired. The Jury without hesitation recommended an Honorary Certificate for the general excellence of these exhibits.

G. P. Farquhar, Dunedin (647), shows specimens of New Zealand Leathers, in Boot Tops and Uppers, the quality and appearance of which are very creditable.

New South Wales.

J. E. Begg, Sydney (2409), shows a quantity of Sole Leather in the rough. The Jury noticed with approval that these exhibits were genuine samples of the exhibitor's ordinary productions, without any attempt being made to get them up only for exhibition. The exhibits, as specimens of sole leather, cannot be surpassed in quality, and the Jury recommended an award in their favor, and expressed regret that the exhibitor had not shown specimens of his other productions.

Victoria.

S. Peardon, Glenmore Tannery, Melbourne, exhibits a quantity of Leather of Victorian manufacture, the quality and general character of which is very good.

Tasmania.

Isaac Wright, Hobart Town (2837), exhibits Kip Leather and Kangaroo Leather of excellent quality; for which the Jury felt justified in recommending an Honorary Certificate.

MANUFACTURES IN LEATHER.

S. W. Silver & Co., London (2968), shew specimens of Portmanteaus, Valises, Bags, &c., of first-class character, for which the Jury recommend an Honorary Certificate should be awarded.

ORNAMENTAL LEATHER WORK.

The art of moulding leather into leaves, flowers, fruit, and other forms, in imitation of carving in wood, for picture and mirror frames, is illustrated by several very well executed specimens, some of which might fairly be considered entitled to special mention.

Mrs. Gribbon, Dunedin (648), contributes several large examples of Ornamental Leather Work; a Mirror Frame, especially, being remarkable for its artistic design and clever execution. Beautiful as these leather

frames undoubtedly are, their utility is more than doubtful, as they are liable to accumulations of dust, which, from the fragile nature of the material, are difficult to dislodge.

The Jury unanimously recommend an Honorary Certificate should be granted to Mrs. Gribbon, for the very high character of her work.

SUB-CLASS *b.*—SADDLERY AND HARNESS.

The demand for Saddlery and Harness in a country where travelling is chiefly accomplished on horseback, and where the transport of goods and materials is almost exclusively done by horse power, is necessarily constant and considerable. It is of the utmost importance, therefore, that soundness of material, excellence of manufacture, and adaptability to the various purposes, should be the points aimed at, rather than cheapness in price. Generally speaking, the export saddlery made in England is of a cheap and inferior description, and not always suitable either in form or construction, for Colonial requirements. The saddler's trade has always, therefore, been one of the earliest local industries established in new settlements, persons preferring rather to have a genuinely-made article even of inferior finish, to the attractive but frequently delusive imported goods. But a considerable improvement has of late years taken place in the character of the harness and saddlery imported from England, ascribable to the fact that local dealers have personally selected their goods, and secured the manufacture of articles suitable for this trade. A still more marked advance has taken place in the Colonial manufacture, and there are manufacturers in New Zealand whose goods rival the best English productions. The Exhibition afforded ample opportunity for comparison, and many of the Colonial goods were not in any way inferior to the English—and particularly in the matter of saddles.

Generally speaking the English exhibits, where shown direct by the manufacturers, were not so good as might have been expected; the best samples having evidently not been sent. The advantages of personal selection were strongly shown in the collection of English goods imported by Bentley Bros., of Dunedin, which were excellent. The Colonial exhibits were in every respect highly creditable, and were as follows:—

Auckland.

47.—W. & A. Kennedy, Leading Harness, Hunting Saddle, Dray Harness, and a Courier Bag, of good sound workmanship, for which the Jury recommended an Honorary Certificate.

48.—R. H. Stevenson, Cart Harness of excellent workmanship.

Otago.

650.—Frazer & Grainger, Dunedin, exhibit Saddles, Bridles, and Buggy Harness, of the highest quality. The fancy embroidered Otago-made side-saddles are models of workmanship. The saddles are of first-class quality and form, and the buggy harness a handsomely mounted and well-made set. The Jury recommend an Honorary Certificate, for excellence of workmanship and general superior character of the goods exhibited.

651.—Falconer & Mitchell, Dunedin—Dray Harness of good quality and workmanship.

653.—J. Low & Son, Dunedin, exhibit a set of Cart Harness, for which the Jury recommended an Honorary Certificate for excellence of workmanship.

654.—Reany Bros., Dunedin, show a very creditable collection of Harness and Saddlery of their own make. A set double buggy harness deserves especial mention, and the Jury recommend this exhibit for an Honorary Certificate.

George Dowse, Dunedin (App. 1089), shows Saddlery, &c., including one very good specimen of Victorian make.

655.—G. A. Smyth, Dunedin, was unanimously recommended for an Honorary Certificate for a Gentleman's Saddle exhibited by him. His Carriage Harness is also good and well made.

Southland.

1213.—John Gellatly, Invercargill, exhibits a Colonial-made Saddle.

The following Exhibitors are Importers of English Saddlery and Harness:—

649.—Bentley Bros., Dunedin, show a case of Saddlery and Harness imported by them, and manufactured under the personal inspection of one of the firm. As specimens of English goods they are the best in the Exhibition, and the Jury feel justified in recommending them for an Honorary Certificate for the general excellence and utility of these goods.

653.—Thomas Lockie, Dunedin, shows a set of Cart Harness of Scotch make, of good genuine manufacture and quality.

New South Wales.

2410.—D. M'Coll, Sydney, exhibits Saddles of his make, which do not display any superiority either in quality or workmanship.

2411.—J. Smith, Botany, shows a set of Cart Harness with Patent Saddle, the advantages of which are not very apparent.

Great Britain.

Charles Greatrex & Son, Walsall (App. 2964, p. 154), exhibit a case

of Saddlery, Harness, and Saddler's Ironmongery, Whips, Brushes, &c The reputation of this firm is hardly confirmed by the class of goods exhibited.

2965.—Henry Brace, Walsall, sends Saddles, Harness, Whips, &c., to which the same remarks may be applied as those made with reference to the preceding Exhibitor's goods.

2967.—F. Milroy & Sons, London, exhibit a Set of Cart Harness, quite unsuitable for the Colony.

2966.—S. Blackwell, Oxford street, London, exhibits through J. Hay, Agent, a variety of articles used in breaking, or training horses. The Jury were particularly struck with a Patent Fomenting Apparatus, for the local applications of hot or cold water. From a tin reservoir strapped on the back of the horse, or to the side of the stall, a stream of water is conducted through an india-rubber tube, and entering another horizontal tube perforated with holes which is strapped round above the joint, or part to be fomented or kept cool. The stream is continuous and regular, thus ensuring most perfect application of the remedy. The Jury recommended the Honorary Certificate should be awarded for this exhibit.*

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

323. SEDGWICK & GOWLAND, Nelson.—Well manufactured Kip and Cordovan Leather.

646. W. BRIDGEMAN, Dunedin.—Leather of Superior Manufacture.

2605. S. PEARDON, Melbourne.—Leather of Superior Manufacture.

2409. J. C. BEGG, Sydney.—Sole Leather of Superior Quality.

2837. ISAAC WRIGHT, Hobart Town.—Kip Leather of Excellent Quality.

2968. S. W. SILVER & Co., London.—Portmanteaus and Bags, well manufactured.

648. MRS. GRIBBON, Dunedin.—Very Superior Ornamental Leather Work.

47. W. & A. KENNEDY, Auckland —Cart Harness of Colonial Leather.

650. FRAZER & GRAINGER, Dunedin— Side-saddles of Superior Workmanship.

653. J. LOW & SON, Dunedin.—Cart Harness.

654. REANY BROS., Dunedin.—Double Buggy Harness.

655. G. A. SMYTH, Dunedin.—Saddle of Superior Workmanship.

649. BENTLEY BROS., Dunedin.—Superior Excellence of Saddlery.

App. 1089. GEORGE DOWSE, Dunedin.—A Saddle of Victorian Manufacture.

2966. S. BLACKWELL, London.—Useful Fomenting Apparatus for Veterinary and other purposes.

* Modifications of this Apparatus would be extremely useful in Human Surgery.—ED.

CLASS XXVII.

ARTICLES OF CLOTHING.

JURORS.

J. A. EWEN. | J. BUTTERWORTH.
T. C. SKINNER.

THE exhibits in this Class not being very numerous, it was considered advisable somewhat to depart from the form of sub-division originally applied, and to divide the exhibits into the following Sub-Classes:—Men's and Boys' Clothing, Bonnets and General Millinery, and Boots and Shoes.

In the various articles of Men's and Boys' Clothing, Silver & Co., of London, (2970), are the most extensive exhibitors. The contributions from the Colony being very limited in number.

MEN'S AND BOYS' CLOTHING.

Thomas Simcoe, Dunedin, exhibits samples of Trousers of his manufacture.

2970.—S. W. Silver & Co., London, contribute a variety of samples of Clothing. The specimens include articles manufactured from cloth and leather.

2969.—The India Rubber, Gutta Percha, and Telegraph Works Co. exhibit, through their Agent, Mr. A. Hay, Dunedin, a variety of Waterproof Clothing—viz., Coats, single and double texture, made from Cambric, Twill, Nainsook, Indian Cloth, &c., prepared specially for the Colonial climate; also, Driving Capes, Inverness Capes, Ladies' Cloaks, Helmets, Caps, and Leggings, Riding Aprons, Chaise Aprons, &c.

BONNETS AND GENERAL MILLINERY.

657.—Ross & Glendining, Dunedin, exhibit a Wedding Outfit, and a Baby's Outfit, made under the superintendence of Mrs. J. M. Bain. These various articles are marked by great taste, beauty of material, and excellence of workmanship.

2606.—Madame De Courtet, Melbourne and Dunedin, shows samples of French Corsets of her manufacture.

Mrs. A. Bunbury, Dunedin, exhibits a Baby Jumper, and Counterpane.

1092 App.—Mrs. Tait, Clutha, sends Socks, and Shawls, knitted and crochet work, of wool. These articles are useful and well made.

BOOTS AND SHOES.

The large consumption of Boots and Shoes in this Colony, invests this branch of Colonial manufacture with considerable importance. According to the statistics of New Zealand for 1863, there were imported into the Colony during that year, boots and shoes to the value of £209,693.* Notwithstanding the great difference in the cost of labor, the production of Colonial-made boots and shoes is increasing, and although it will be a long time ere we can entirely depend on the local supply, there can be no doubt that there is room for a large extension of the trade. The specimens of Colonial manufactured boots and shoes are most excellent in every respect, and in no way suffer by comparison with any of the British goods; while they have the additional advantage of being made to meet special Colonial requirements. The following is a list of the exhibits :—

446.—C. M'Nicol, Canterbury, shows samples of well-made Cloth-legged Balmorals, price £2; Elastic-side Plain Boots, price 28s; and Watertights, price 27s.

447.—J. Suckling, Christchurch, exhibits a case of Boots of his manufacture. The prices affixed to the samples are moderate, and the workmanship and finish good.

658.—J. Mollison, Dunedin, shows Boots and Shoes of his manufacture, which for general excellence are not surpassed by anything in the Exhibition.

659.—Phil. Beck, Port Chalmers, shows well-made Boots and Shoes.

647.—G. P. Farquhar, Dunedin, exhibits a number of "Uppers," manufactured from leather made at the Caversham tannery, near Dunedin.

1091 App.—John Switzer, Dunedin, displays a large case of samples of imported Boots and Shoes of every kind, from the heavy hob-nailed digger's boot to the costly gold-embroidered dancing slipper of the lady. The whole of the specimens are first-class of their kind.

2971.—William Wilson and Sons, London, exhibit samples of Boots and Shoes.

2839.—T. P. Smith, Hobart Town, shows a pair of Lady's Boot Tops,

* Imports for 1864, are not yet published.—ED.

sewed by a sewing machine made by exhibitor, mentioned in the Report on Class VIII.

2840.—Joseph Davis, Hobart Town, exhibits a pair of Lady's Seamless Boots of Kangaroo Leather, goloshed with patent leather. The uppers are without seam at the heel or front, and lace up the inside.

D. H. Pollak, Vienna, sent a selection of Ladies' and Gentlemen's Boots and Shoes manufactured by him. These goods were remarkable not only for the excellence of their workmanship, but also of the materials used in their manufacture; and were recommended for an Honorary Certificate.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

657. ROSS & GLENDINING, Dunedin.—For Millinery of Superior Taste and Workmanship.

2606. MADAME DECOURTET, Melbourne.—Corsets.

1092. MRS. TAIT, Clutha.—Hosiery, Socks, and Shawl of New Zealand Wool.

446. C. MCNICOL, Christchurch.—Boots of Excellent Workmanship.

447. J. SUCKLING, Christchurch.—Boots of Excellent Workmanship.

658. J. MOLLISON, Dunedin.—Boots of Excellent Workmanship.

659. PHIL. BECK, Port Chalmers.—Boots of Excellent Workmanship.

1091. JOHN SWITZER, Dunedin.—Very Superior Home and Dunedin made Boots and Shoes.

—. D. H. POLLAK, Vienna—Boots and Shoes of excellent material and manufacture.

CLASS XXVIII.

PAPER, STATIONERY, PRINTING AND BOOKBINDING.

JURORS.

W. SHAW, *Chairman.*

DANIEL CAMPBELL. | J. HISLOP.

THE production of paper is an industry which has not as yet been established in New Zealand, although this Colony contains a great variety of paper-making materials. Foremost amongst them is the *Phormium tenax*, or native flax, the fibre of which has been proved to be a valuable paper-making material. Specimens of the paper made from it are shown in the Exhibition; notably in a pamphlet on the *Phormium tenax*, by Jno. Murray, F.S.A., contained in the collection of exhibits shown by W. Colenso, of Napier. The paper on which this work is printed, combines several excellent qualities, being exceedingly tough and in its general character somewhat like that used for Bank of England notes. The color is objectionable, being a brownish tint, and the paper contains a considerable number of extraneous particles, the result, no doubt, of defective manufacture and bleaching. Beyond a few experimental attempts, no effort has been made to employ the fibre of the *Phormium tenax* in the manufacture of paper, but the Canterbury collection contains specimens of the results of a recent attempt by Robt. Cameron, a local manufacturer, to utilise this fibre in the production of paper. These specimens, although only representing the preparatory stage of paper-making, producing what is technically called "half-stuff," are however very interesting, as showing what can be accomplished with this material. The Jury are not aware that the exhibitor has yet succeeded in producing a marketable paper, but it is understood that no difficulties, which cannot be surmounted, exist in the way of establishing this important branch of manufacturing industry.

Besides the *Phormium tenax* there are many other fibrous plants indigenous to New Zealand, which yield paper-making material, but as yet nothing has been done in the way of utilising them, except in one instance. Edward McGlashan, an old Otago colonist, has with praiseworthy spirit, made several experiments with the view of converting some of the fibrous grasses into paper. The Snow Grass (*Schœnus pauciflorus*, Hook. fils), which grows profusely in certain districts in the interior of Otago, is very fibrous, and the trial made with this material proved that a very fair paper of common quality can be made from it. Grasses of this description are however most suitable for mixing with rags, as they scarcely possess sufficient strength of fibre to be employed alone. It is not to be expected, however, that the utilisation of these fibrous grasses will receive any extensive practical application until greater facilities exist in the shape of cheap conveyance and labor.

The Native flax undoubtedly offers many advantages as a paper-making material, and it is the opinion of many practical persons that its conversion to this purpose presents much fewer difficulties than attend its preparation for textile manufactures. Public attention has been quite recently drawn to this subject, and the Provincial Government of Otago, acting on the recommendation of the Council of that Province, has offered a bonus of £500 to the person or company who shall first produce, within twelve months, a ton of paper from the *Phormium tenax*, or other indigenous fibre, equal in quality and price to imported paper. It is extremely doubtful if the conditions of this bonus will be complied with, as it would probably be more profitable to export the material in a preparatory stage of manufacture. The fibre of the *Phormium tenax* is so strong that its reduction to the requisite condition for paper requires powerful machinery and considerable labor, and it is probable that even in England the paper manufacturer would prefer to use it in conjunction with less valuable material.

The exhibits of Paper included a set of samples from Arnold and Politzer, of London, and specimens of Drawing Paper from P. Ibbotson and Sons, New Slough, Bucks, (2972). The samples of the first-named exhibitors comprise a great variety of paper, and were accompanied by full details as to weight and price. The drawing paper of P. Ibbotson and Sons is of commendable quality.

The display of Printing, Engraving, and Lithography is on the whole creditable to the Colony. There is no reason why, except in the higher branches of engraving and ornamental printing, we should not produce as

good examples of the art in this Colony as the printers of Europe. The higher rate of wages has attracted to the Australian Colonies some excellent mechanics, and some of our principal printing establishments are provided with machinery of the latest construction. The printing of the Colonial newspapers is quite on a par with that of many English journals, and books have been printed and published in this Colony, the typography of which is very creditable.

In Engraving and Ornamental Printing very great advance has been made of late years. Wood Engraving as an art is as yet almost unpractised in New Zealand, the demand for works of this character not being sufficient to attract skilled artists, or to induce local effort. On the other hand, plenty of occupation is found for Lithography, and for some years we have been independent of foreign aid with reference to engraving and lithography for commercial requirements. Latterly, the art of Chromo-Lithography has taken root, and is likely to flourish.

The exhibits of Engraving, by Fergusson & Mitchell, Dunedin (664), and Ward & Reeves, Christchurch (448 to 451), are in every respect of great merit, and would bear comparison with the productions of London engravers. Ward & Reeves show also examples of Chromo-Lithography, including an interesting series representing the various tints printed from the separate "stones," which, combined, form the perfect picture. These Exhibitors were the successful competitors for the premium offered for a design for the Honorary Certificates to be presented by the Commissioners to successful Exhibitors.* The reproduction of the original by Chromo-lithography was also entrusted to them, and both the original design and the chromo-lithographs of it reflect great credit on Ward & Reeves, and have elicited warm praise from all quarters.

452.—Doyle & Co., Christchurch, exhibit specimens of Engraving and Lithography of good character.

In Commercial Stationery and Account Books, &c., Fergusson & Mitchell, Dunedin (664), deservedly call for special mention. The Ledgers and other Office Books exhibited by this firm are of most excellent character. The ruling is clear and regular, the binding sound and substantial, the books open free and flat, and are in every respect equal to the best London workmanship. A. R. Livingston and H. Wise, of Dunedin, also exhibit specimens of ruling and binding.

* Messrs. Ward & Reeves, in acknowledging the award of this premium, request mention to be made that the merit of the design is due solely to Mr. Henry Heath Glover, a lithographic writer in their employment.—ED.

The Commercial Books exhibited by Walch & Sons, Hobart Town (2841 and 2), were excellently bound, but were defective in ruling. Walch and Sons exhibit examples of Ornamental Binding in Morocco, and Calf, of a very high degree of excellence.

W. C. Belbridge, Brisbane, Queensland (2706), sends, as samples of Printing and Bookbinding, volumes of the Parliamentary Reports, &c., of that Colony.

HONORARY CERTIFICATES.

451. WARD & REEVES, Christchurch.—Illustrations of Chromo-Lithography.

664. FERGUSSON & MITCHELL, Dunedin.—Excellence of their Book-binding and Machine-ruling.

2841-2. WALCH & SONS, Hobart Town.—Superior Book-binding.

CLASS XXIX.

EDUCATIONAL WORKS AND APPLIANCES.

SUB-CLASSES *a.* & *b.*

JURORS.

REV. F. C. SIMMONS.	REV. D. M. STUART.
J. HISLOP.	J. S. WEBB.

THE precedent of setting apart a distinct Class for the exhibition of Educational Works and Appliances, was first established at the Great International Exhibition in 1862, and was attended by the most satisfactory results; works and objects illustrative of the various branches of education, and of the modes and processes followed in other countries, formed a collection the value and importance of which it would be impossible to overestimate. In adopting a similar course in the New Zealand Exhibition it was hoped that similar results, though in a minor degree, would follow, and that those interested in the subject of education might thus obtain valuable hints and information.

It is to be regretted, that, excepting as regards the higher branches of education, but few objects or works are exhibited. It would have been an interesting feature if the various books employed in the public schools of the Colony had been exhibited, as well as, if possible, illustrations of the system of instruction followed. The omission of these desirable objects is to be regretted, and it is unfortunate that primary education is very inadequately represented in the Exhibition. As was remarked in the report of the Jury on this class in the Exhibition of 1862, "An educational exhibition must mainly illustrate processes rather than results. It can display the structure and fittings suited for places of instruction, and

can show what are the expedients—literary, pictorial, or mechanical—by which instruction may be facilitated. . . . The higher education of a country, is to a great extent incapable of being exhibited or visibly illustrated. . . . As we descend lower in the scale of instruction, the importance of educational 'appliances' becomes relatively greater; and hence the equipment of a primary school, and especially of an infant school, is necessarily more elaborate, and furnishes much more material for an Exhibition;—not because it is more important, but because here the senses have to be educated, and simple manual arts have to be learned, while the power to exercise thought is yet comparatively undeveloped."

SUB-CLASS *a*.—BOOKS AND MAPS.

It is a singular circumstance that in the public schools of the Colony, little or no attention whatever is paid to instructing the children in the history or geography of New Zealand, and that no elementary books on these subjects have been published. It is surely of as much importance that the children of the colonists should know something of the land they live in, as to become acquainted with the history and geography of other countries. A well compiled History and Geography of New Zealand, written especially for the use of schools, is a want that ought not to remain long unsupplied.

Included among other Exhibits catalogued in this Class, are a number of old and rare books; exhibited more as curiosities than anything else, and the Jury felt in some difficulty as to the mode in which they should deal with them. Some of these works are undoubtedly instructive, whilst many are of value, both as illustrating the art of printing and as affording a comparison with the literature of the present day.

In respect to Maps and Illustrative Diagrams, it is highly important that the geography, topography, and geology of the country should be correctly indicated, and the Jury noted with satisfaction that the various maps prepared and executed in the Colony, are of the highest order of merit. The Jurors desire to draw especial attention to the Geological Section of the Lyttelton Tunnel Works, by Dr. Julius v. Haast, which appears to have been compiled from very elaborate data; and to be, so far as the Jurors are aware, unique of its kind. The Jurors hope that when completed it will be published, with all the details possible. The efforts that have been made to educate the Maoris are illustrated by copies of the various books in the aboriginal tongue which have been printed from time to time. The first attempt to reduce the Maori language to

writing was in 1820, when a Grammar of the Language of New Zealand was compiled by Professor Lee, of Cambridge, aided by Hongi, Waikato, and Mr. Kendall. In 1830 and 1832, several portions of the Scriptures, Catechisms, and Spelling Books, in the Maori tongue, were printed at Sydney, and in 1835 the first book was printed in New Zealand; the Epistles to the Ephesians and Philippians in Maori, translated and printed at Pahia by Mr. W. Colenso; a copy of this is exhibited. The first Maori Almanacs were published in 1839 and 1840. Since then the whole of the Bible has been translated and printed, and a number of religious and educational books are freely circulated amongst the Natives. In 1842 a Grammar of the New Zealand Language was compiled by the Rev. R. Maunsell, and in 1843 an Instruction Book of the English Tongue for the use of the Maoris was published. In 1844, a Dictionary and Grammar of the New Zealand Language by the Rev. W. Williams, was published, an improved edition of which was published in 1852; this is considered the best Maori Dictionary. In 1848, a newspaper called *Te Karere Maori*, or the Maori Messenger, was commenced at Auckland by the Colonial Government. It was printed in English and Maori, and circulated gratis amongst the Natives. In 1853, a valuable work on the Poems, Traditions, and Chaunts of the Maoris, by Sir George Grey, K.C.B., was published at Wellington. Translations of some of the Traditions were published in London in 1854. In 1861 the Waikato Maoris started a newspaper of their own.

With reference to the educational status of the Maori population, it may be said that fully one-half of the adult population can read their own language; one third can write, add up figures, subtract and multiply, while instances are occasionally found of higher attainments. In 1849 schools were established and endowments granted for the education of the Maori youth, and in 1858 a Bill was passed by the General Assembly appropriating £7000 annually for these schools for a period of seven years.

The following figures from the Census Returns of 1861, show the proportion per cent. of each degree of education to the population of Europeans in the respective years:—

		1858.	1861.
Cannot read	..	25.19 per cent	22.32 per cent
Read only	..	11.30 „	9.01 „
Read and Write	..	63.51 „	68.67 „

The marked improvement shown above has no doubt been maintained,

and the Census Return of 1864* will, it is believed, show a still higher educational ratio.

Auckland.

Thos. A. Fairs exhibits a number of Old Books, some of which are very curious. They comprise (49) a Treatise on Cosmography, by M. Blundeville, illustrated with quaint wood engravings; Black Letter, 1594. (50), A Treatise on Arithmetic, in Black Letter, dedicated to Prince Edward, afterwards King Edward VI. (51), A Copy of Bishop Latimer's Sermons, in Black Letter, 1578, with wood engraving of his preaching before King Edward VI. (53), Illuminated Prayer Book, originally used by His Majesty Charles II.; the binding modern. (54), Short Sketches of the Ancient Greeks and Romans, illustrated with woodcuts, 1524. (55), Specimens of Modern Illuminated Printing, by H. M. Humphrey, Esq., of the "MS. of Froissart." (52), Copy of the *Sun* Newspaper,—the Coronation of Queen Victoria, printed in gold.

His Excellency Sir George Grey, (58*a*), contributes some rare and valuable Manuscripts, viz :—

1. Boece, Livre de Consolation ; translated per Maistre Johan de Mihun. MS. on vellum, 14th century. Initial letters in gold and colors, with a miniature of the author dictating to his scribe. 1 vol. folio.

2. Breviarum Romanum : Italian MS. on vellum, 15th century. Numerous small miniatures in the capital letters. 1 vol. folio.

3. Hora B. M. Virginis secundum usum Sarum. English MS. on vellum, 15th century, with 25 large miniatures. 1 vol. 4to.

4. Missal ad usum Romanum. French MS. on vellum, 15th century ; 4 large miniatures, 63 small miniatures. 2 vols. 4to.

J. Kemp, sen., (68), sends a Book of First Lessons in Maori, old edition.

Hawke's Bay.

August Koch, Government Draughtsman, (148), exhibits a Map of the Province of Hawke's Bay, showing lands purchased by private individuals, land still in the hands of the natives, and Government land open for selection. Also, (149) small Map, showing the geological features of the Province.

W. Colenso, Napier, (168), exhibits a very valuable and interesting collection of works, viz :—

* The corresponding information resulting from the Census taken on the 1st December, 1864, is not yet published—Nov. 14th, 1865.—ED.

(1.) 6 Vols. Flora Antarctica; (2.) 9 Vols. Government Edition, Cook's Voyages, 4to., with Atlas, Maps, and Plates; (3.) Raoul's Plantes, Middle Island, folio; (4.) Forster's Generum Plantarum; (5.) Owen's Monograph, Moa; (6.) Owen's Monograph, Apteryx.

BOOKS PRINTED IN NEW ZEALAND.

(7.) New Testament, Bay of Islands, 1837; (8.) Common Prayer, (Church of England), Bay of Islands, 1840; (9.) First Book printed in New Zealand—Epistles to the Ephesians and Philippians, 12mo., February, 1835; (10.) First English book printed in New Zealand —Report of the Temperance Society, Bay of Islands, 1836; (11.) First English Sermon printed in New Zealand, 1842; (12.) Two Maori Almanacs, 1841 and 1843—first ones were published in 1839 and 1840; (13.) Ten of the Earliest Printed Public Papers, in covers, 1835-1840, including Treaty of Waitangi, (original Maori); the N. Maori declaration of United Independence, 1835; (14.) The first "Government Gazette," 1840.

BOOKS RELATIVE TO NEW ZEALAND, BUT PRINTED IN SYDNEY AND HOBART TOWN.

(15.) First Book Printed for New Zealanders: Viscount Goderich's Letter, &c., English and Maori, 1833; (16.) "Journey of a Naturalist in New Zealand," 1842, (by Exhibitor); (17.) *Filices Novæ* of New Zealand, by ditto; (18.) Murray on *Phormium Tenax*, &c., the paper of the book being manufactured from *Phormium tenax* (New Zealand Flax).

Wellington.

George Hunter (225), exhibits a volume of the Pilgrim's Progress, in Maori.

J. C. Crawford (276), exhibits three Geological Maps of the Province of Wellington.

Nelson.

Charles Elliott (325), sends a Map of the Province of Nelson; a Stud-Book (325*a*) containing the pedigrees of Race Horses from the first introduction of the horse into New Zealand, compiled by the Exhibitor; also, Haast's Report of the Topographical and Geological Exploration of the Western District of the Province.

J. L. Bailey (326) exhibits the Nelson Almanac, Directory, and Year Book for 1865, compiled by the exhibitor.

330.—The Provincial Government contributes an Index Plan of the Province, with several of the Sectional Maps on an enlarged scale, and Maps of the West Coast, Grey, and Buller Gold-fields.

Canterbury.

445.—Thomas Cass, Chief Surveyor, contributes a Map of the Province of Canterbury, on the scale of four miles to one inch; (446) Lithographed Maps of the Road Districts in the same Province; and (447) a Report on the Survey of Canterbury from 1848 to the end of 1864.

458 *et seq.*—Julius v Haast, Ph.D., F.G.S., F.L.S., Knight of the Order of Francis Joseph of Austria, Member of the Imperial German Academy of Naturalists, and Provincial Geologist, forwards a series of valuable Geological Maps and Sections, admirably illustrating the geology of the various districts of the Province, viz.:—(458) Sketch Plan of Canterbury, showing the glaciation during Pleistocene and recent times; (459) Geological Map; (460) Geological Sections across the Province; (461) Geological Sections across Malvern Hills; (462) Geological Sections of Grey and Buller River Coal-fields; (463) Sketch Map of Canterbury Plains, lithographed; (464) Sections parallel to the rivers of Canterbury Plains; (465) Sections across the Canterbury Plains; (467) Illustrated Popular and Scientific Work on New Zealand, by Dr. Frederick von Hochstetter.

Otago.

667.—Several Maps of the Gold-fields of Otago are exhibited by Vincent Pyke, Secretary of Gold-fields, compiled and drawn by the officers of the Gold-fields Department, viz.:—

Detailed Map of the Province, showing the various Gold-fields, drawn by W. F. Browne—a most admirable specimen of drawing.

Detailed Map of the Wakatipu Gold-field, compiled and drawn by Messrs. Wright and Miller.

Map of the Dunstan Gold-field, by J. J. Coates.

Detailed Map of the Tuapeka Gold-field, compiled by J. Drummond.

Geological Maps of Victoria and five Maps of the Mining Districts of Victoria.

668.—John Hay, exhibits a Self-testing Arithmetic Book.

670.—James Hector, M.D., F.R.S.E., F.G.S., Provincial Geologist,* sends Geological Maps and Sections, drawn by J. Buchanan.

671.—J. T. Thomson, Chief Surveyor, contributes a large Map of the Province of Otago; a Key Map of Survey Districts, lithographed; and a small Map of the Province and of Dunedin and Suburbs. It is to

* Now Director of the Geological Survey of New Zealand.—ED.

be regretted that the names of the officers who compiled and drew these maps are not given by the exhibitor.

In the Museum Collection of the Provincial Geologist, Dr. Hector, are some most exquisite drawings of Tertiary Fossils (845 *et seq.*), by J. Buchanan, Draughtsman and Botanical Collector;* and various admirable Geological Maps and Sections by Dr. Hector, also drawn by J. Buchanan.

856.—Geological Section, Dunstan Ranges, to the mouth of the Waitaki River.

857.—Geological Section, along the Coast, between the Molyneux River and Coal Point.

858.—Geological Section of Goldfields, from Tokomairiro River to the Lammerlaw Ranges, 35 miles.

859.—Geological Section, from Flagstaff Hill along Chain Hills to the Sea.

860.—Geological Section, Oamaru Cape and Otepopo.

861.—Sundry Sections of Goldfields.

862.—Geological Diagrams of Goldfields.

863.—Diagramatic Section across the Province of Otago, from Milford Sound to the mouth of the Waitaki River.

865.—Geological Map of the Province of Otago, scale of eight miles to the inch, with unpublished Geographical Details of the West Coast District.

866.—Map of the N.W. District of Otago, colored to show the surface configuration and form of the Alpine Valleys.

867.—Sectional Plans of some of the Sounds of the West Coast, and of the Wakatipu Lake, illustrating the manner in which their containing valleys have been formed.

868.—Geological Maps of various Local Districts in the Province.

869.—Illustrative Diagrams of Meteorological Observations taken at the Dunedin Observatory since 1862, by R. B. Gore, Meteorological Observer.

864 App.—A series of most interesting views, illustrative of the Geological features of Otago Scenery, by John Buchanan, Draughtsman and Botanical Collector, from Dr. Hector's and his own sketches.—1. Panoramic View of Wakatipu Lake, from near Queenstown. 2. Indian Ink Sketch of Mount Alta, Wanaka Lake District, with White Birch Bush. 3. Sketch of Upper Clutha Valley, from Mount Alta Range. 4. Sketch

* Now of the Geological Survey of New Zealand.—ED.

in a Black Birch Bush. 5. Sketch of the Upper Clutha Valley, from Lindis Range, illustrative of the Terrace Formation. 6. Waterfall, head of Milford Sound, 540 ft. perpendicular. 7. Indian Ink Sketch on Bigstone Creek, Wanaka Lake District. 8. Waterfalls on Cascade Creek, Matakitaki River. 9. Sketch on the Wanaka Lake, Mount Aspiring Range in the distance. 10. Sketch on the Left Branch of the Matakitaki River, Mount Aspiring from the West. 11. View of Jackson's River, (Canterbury Province), from Pigeon Hill, looking seawards. 12. Sketch from the Crown Terrace, near the Arrow River, looking towards Wakatipu Lake. 13. Head of Milford Sound, looking down. 14. Sketch on the Clutha River, near the Tuapeka Creek, with Gull Island. 15. Head of Wakatipu Lake, from Von Tunzleman's. 16. Sketch in Milford Sound. 17. Panoramic View of Wanaka and Kawea Lakes.

876 App.—Dr. Hector also sends some most beautiful drawings from nature, by J. Buchanan, of Alpine plants.

No. 1, *Coprosma lucida*, Forst.
Plagianthus Lyallii, Hook. f.

No. 2, *Ranunculus Buchanani*, Hook. f. new species.

No. 3, *Helophyllum Colensoi*, Hook. f. new species.
H. rubrum, Hook. f. new species.
H. clavigerum, Hook. f.
Forstera sedifolia, Lin.

No. 4, *Hectorella cæspitosa*, Hook. f. new species.
Myosotis pulvinaris, Hook. f. new species.
Colobanthus acicularis, Hook. f. new species.
Donatia Novæ Zelandiæ, Hook. f.

No. 5, *Abrotanella inconspicua*, Hook. f. new species.
Raoulia grandiflora, Hook. f.
Plantago lanigera, Hook. f. new species.
Veronica Hectori, Hook. f. new species.

No. 6, *Claytonia australasica*, Hook. f.
Myosotis Hectori, Hook. f. new species.
Ourisia cæspitosa, Hook. f. new species.

No. 7, *Celmisia Hectori*, Hook. f. new species.
C. sessiliflora, Hook. f. new species.
Brachycome Sinclairii, var. y. Hook. f. new species.
Senecio cassinioides, Hook. f. new species.

No. 8, *Ranunculus pachyrrhizus*, Hook. f. new species.
Ourisia glandulosa, Hook. f. new species.
Ligusticum imbricatum, Hook. f. new species.
Braya Novæ Zelandiæ, Hook. f. new species.

No. 9, *Ranunculus Lyallii*, Hook. f. new species. One-third the natural size.

672.—H. Waymouth, Dunedin, exhibits an Orrery, and Educational Diagrams. The Jury desire to mention with praise the name of the

publisher* of these diagrams. They were the only exhibits of the sort until the late arrival of some of W. and A. K. Johnston's.

1096 App.—W. D. Gray, Rocklands, exhibits a large Illustrated Work on New Zealand, by Angus, a continuous source of interest to the visitors.

1098 App.—H. H. Gerrand, Dunedin, contributes a copy of Gould's valuable work on Australian Birds. The Jury desire to recognise the great value and interest of the two last-named exhibits, and the obligation conferred by the exhibitors in thus giving access to works which are out of the reach of most visitors.

1101 App.—Joseph Mackay, Dunedin, exhibits an Autograph of Burns the Poet, and a number of Pamphlets relating to the early history of Otago.

Southland.

1216 App.—J. H. Baker, Invercargill, for the Provincial Government, exhibits a Map of the Southland Hundreds, engraved by T. Wyld, London. An excellent map for which an Honorary Certificate was recommended.

1218 App.—S. Weetman, Invercargill, for the Provincial Government, exhibits a Topographical Map of Southland. A very excellent map, also recommended for Honorary Certificate.

Tasmania.

2842.—Walch & Sons, Hobart Town, send, as publishers, Maps of Tasmania. A large one, engraved and printed by W. & A. K. Johnston, of Edinburgh, from drawings by Mr. Hogan, of the Survey Department, Hobart Town. Also, a Map of the Seat of War in New Zealand, 1863, drawn by Mr. Piguenot. A Volume of Music, by Tasmanian composers; three Volumes of Walch's Literary Intelligencer, a monthly publication; and several other Publications of the Firm.

New South Wales.

2412.—R. Davidson, Sydney, Surveyor-General, sends well executed Topographical Maps of the Colony.

Great Britain.

2973.—The Committee of Council on Education, London, contribute a Set of 41 Drawings, illustrating the Course of Instruction pursued in the Schools of Art which receive assistance from the Government. This is a most valuable collection, and it was a matter of great regret with the Jury that these drawings could not be retained in the Colony, to which they would have been of permanent value.

* Unknown; the Exhibitor refusing to supply the information.—ED.

2974.—Edward Stanford, London, the well-known publisher, exhibits New School Maps of Europe, Holy Land, and Australia, price on rollers 13s. each—very good and useful.

2975.—Smith & Son, Charing Cross, London, send Maps and Globes —the Map of the World, constructed under the Commissioners for National Education in Ireland,—worthy of commendation for their general excellence, and the assistance they afford beginners by the clearness of their explanations.

2976.—W. & A. K. Johnston, Edinburgh, contribute one Case of Maps and Educational Diagrams, which the exhibitors have presented to the Commissioners.* The universally acknowledged excellence of the works of these exhibitors renders any comment by the Jurors unnecessary.

HONORARY CERTIFICATES.

148. AUGUST KOCH, Hawke's Bay—For Map of the Province of Hawke's Bay.
330. PROVINCIAL GOVERNMENT, Nelson—Index Plans of the Province.
325. CHARLES ELLIOTT, Nelson—Map of the Province of Nelson.
458. JULIUS V HAAST, Canterbury—Maps and Sections, admirably illustrating the physical characters of the Province of Canterbury.
667. W. F. BROWNE, Dunedin—Map of the Gold-fields of Otago.
667. WRIGHT & MILLER, Wakatipu—Map of Wakatipu Gold-field.
667. J. DRUMMOND, Tuapeka—Map of Tuapeka Gold-field.
667. J. J. COATES, Dunstan—Map of Dunstan Gold-field.
670. JAMES HECTOR, Dunedin—Maps, Plans, and Sections, admirably illustrating the geology and natural history of Otago.
671. J. T. THOMSON, Dunedin—Map of the Province of Otago.
864. JOHN BUCHANAN, Dunedin—Sketches and Drawings from Nature.
672. HENRY WAYMOUTH, Dunedin—Educational Appliances.
869. R. B. GORE, Dunedin—Diagrams illustrating the Meteorology of Otago.
1216. J. H. BAKER, Invercargill—Map of Southland Hundreds.
1218. S. WEETMAN, Invercargill—Topographical Map of Southland.
2412. R. DAVIDSON, Sydney—Topographical Map of New South Wales.
2842. J. WALCH & SON, Hobart Town—Map of Tasmania.
2974. EDWARD STANFORD, London—Excellence of School and other Maps.
2975. SMITH & SONS, London—Excellent Maps.
2976. W. & A. K. JOHNSTON, Edinburgh—Excellent Maps and Educational Diagrams.

---

* Presented by the Commissioners to the HIGH SCHOOL, Dunedin.—ED.

CLASS XXIX.

SUB-CLASS *c*.—APPLIANCES FOR PHYSICAL TRAINING, INCLUDING TOYS AND GAMES.

THE classification of "Appliances for Toys and Games" under the head of "Educational Works and Appliances" by the Commissioners of the International Exhibition, 1862, instead of, as in 1851, under that of "Miscellaneous Manufactures and Small Wares," is a healthy indication that, physical training is asserting something like its equality with mere mental education.*

Great Britain is pre-eminent amongst nations for the production of articles intended by way of amusement to promote the development of physical power. Many years ago, the late Duke of Wellington said that the battles of the British Army were won in the playing-fields of the great public schools, and he was a close observer, with an experience of how battles are won, possessed by few. And as long as a healthy body is necessary to a healthy mind—as long as skill, courage, self-reliance, and the capacity for endurance—the will, (even when the blood is hottest and restraint most irksome), to submit to privation and hard work as the necessary accompaniments of "*training*"—are necessary to the athletic exercises daily practised throughout the length and breadth of the grand old country from which we have sprung, we may rest assured that, whatever may betide her, she will preserve for future generations the liberties she has so nobly won. Her children now colonizing so many portions of the globe have for the most part carried with them the same healthy ambition to excel in manly games. Long may cricket and football, rowing, yachting, hunting, shooting, and fishing, be the amusements at Home and in the Colonies! The splendid army of Volunteers that has quietly grown into existence during the last few years, and which still gathers strength, could never have arisen had it not been consonant with the thletic sports of the people.

* The miserable apology for a playground at the Dunedin HIGH SCHOOL is a disgrace to the community.—ED.

There is only one exhibitor in this important Sub-Class, John Lillywhite, London (2977), whose name is a household word to every lover of Cricket. Mr. Lillywhite's exhibits, unfortunately, through shipping delays, only arrived just before the close of the Exhibition, consequently were seen by but few even of those visitors especially interested in them. They include a fine display of Bats of the most esteemed kinds, and every other appliance for the game of cricket, except wickets. From their late arrival they could not be submitted to a Jury, but the Commissioners awarded Mr. Lillywhite an Honorary Certificate, not only for the excellence of his cricket materials, but as the only exhibitor of articles intended to assist in Physical Education.

HONORARY CERTIFICATE.

2977. JOHN LILLYWHITE, London—Cricketing Materials.

CLASS XXIX.

SUB-CLASS *d.*—SPECIMENS AND ILLUSTRATIONS OF NATURAL HISTORY AND PHYSICAL SCIENCE.

JURORS.

REV. F. C. SIMMONS.	J. S. WEBB.

FEW countries offer a more varied field for the researches of scientific men than New Zealand, and its attractiveness is heightened by the fact that although much has been accomplished in the investigation of these interesting islands, there is still ample room for further discoveries. Ever since the discovery of these islands by Cook, New Zealand has attracted the attention of scientific men. The Geologist, the Botanist, and the Ornithologist, each have pursued their investigations and researches, which have resulted in many valuable acquisitions to scientific knowledge, and discoveries of incalculable benefit and importance to the colonists. Cook, Banks, Solander, Dieffenbach, Lyell, Hooker, Forbes, Owen, Mantell, Taylor, Colenso, Heaphy, Hochstetter, Haast, and Hector, constitute no mean array of names of eminent scientific men, to whose labors we are indebted for our knowledge of the Natural History and physical conditions of the Colony.

It is satisfactory to be able to say that the illustrations of Natural History and Physical Science, contributed from various sources to the Exhibition, were very extensive and complete, and constituted a chief source of attraction. At no former period has there been gathered together so complete a series of specimens, and never before have the people of New Zealand had such an opportunity of making themselves acquainted with the natural history of the land they live in. It would be impossible to speak too highly of the magnificent collections exhibited by Dr. Hector, for the Provincial Government of Otago, and by Dr. Haast, for the Pro

vincial Government of Canterbury. Extensive, carefully classified, and beautifully arranged, they formed one of the most instructive features of the Exhibition, and, judging from the eager attention with which these collections were regarded by the visitors, there is every reason to expect that many important and valuable lessons will have been taught by their means, and their value as educational means and appliances be fully proved. Second only in extent in this Class, and also valuable for purposes of illustration and comparison, comes the collection contributed by Dr. Lauder Lindsay, of Perth—a gentleman who was one of the first to investigate the geological conditions of Otago.

The Botanical, Ornithological, and Conchological collections, were highly interesting. The collection of Birds exhibited by Dr. Hector has certainly not been equalled by any previous collector for extent and completeness, and the specimens contributed by Mr. Buller of Canterbury were, if less numerous, equally interesting. The Herbary of plants, ferns, mosses, and seaweed compiled by Mr. Buchanan, the Botanical Collector for the Otago Museum; and the specimens of ferns exhibited by other collectors, illustrated fully these several branches of the botanical features of the Colony.

Many private collectors of geological and mineralogical specimens, forwarded the results of their industrious researches, some of whom betrayed in the classification of their specimens, considerable knowledge of physical science, whilst others were evidently mere gatherers of pleasing natural objects. The educational character of geological or other scientific specimens is due to the practical lessons which their proper classification, together with the information as to the conditions under which they exist or existed, teach. The mere grouping of a confused variety of specimens, without regard to these particulars, is comparatively speaking, a waste of time and labor, yielding no instruction and affording only an inferior degree of pleasure.

We proceed to notice the various exhibits under this Sub-Class.

Auckland.

59.—His Excellency Sir George Grey, K.C.B., contributes a well-mounted and carefully classified collection of Ferns, stated to have been compiled and arranged by the Misses Sinclair, daughters of the late lamented Dr. Sinclair of Auckland. His Excellency likewise exhibits a book of the Mosses of New Zealand, collected and classified by Dr. Knight. This collection may be considered unique.

61.—The Local Committee of Auckland, exhibit a considerable

variety of articles, from the Auckland Museum, but which from the absence of all proper arrangement, can scarcely be said to deserve any notice at the hands of the Jury. The geological and mineralogical specimens, were especially badly arranged, if the term arrangement can be applied to a confused heap of stones, many of the specimens being wrongly labelled and others without labels at all. The collection contained specimens of the following:—

No. 1. Gold in Quartz, section of a Nugget from Coromandel. 2 and 3. Auriferous Quartz, from Coromandel. 4. Gold and Silver. 5. Copper Ore, from the Kawau. 6. Copper Ore, from the Great Barrier Mine. 7. Copper Ore, from Wangapurapura. 8. Ores, from Kawau. 9. Ores, from Great Barrier Island. 10. and 11. Manganese, from Waiheke. 12. Jasper, from Coromandel. 13. Jasper, from Coromandel, (polished). 14. Jasper, from Wangaprawa. 15. Agate, from Coromandel. 16. Cornelians. 17. Alum, from Rotomahana. 18. Fuller's Earth, from Great Barrier Island. 19. Fuller's Earth, (white) from Hot Springs. 20. Pumice, from Waikato. 21. Coal, from Poor Knights. 22. Coal, from Matakana. 23. Coal, from Kawhia. 24. Coal, from Drury. 25. Fossils, from Coal, seven miles South of Waikato Heads. 26. Fossils, from Coalfield, Drury. 27. Siliceous Deposit of Tarata Boiling Spring. 28. Sulphur, from White Island. 29. Sulphur, from Hot Lakes. 30. Building Stone. 31. Gray Trachyte, from Coromandel. 32. Red Trachyte, from Coromandel. 33. Sandstone, from Papakura. 34. Ochre, from Drury. 35. Sienna. 36. Material for Bricks, (assorted), Auckland.

Several articles mentioned in the Catalogue could not be found by the Jury, amongst which may be mentioned the specimens of Orchilla weed and of Sponge.

The collection of specimens of the Woods of the Province lost much of its attractiveness, owing to their damaged and soiled condition, which a little repair and polishing would have obviated.

60.—A very interesting and well-arranged Book of Ferns, collected and mounted by the Students of St. John's College, Auckland, is exhibited by the Rev. Mr. Blackburn, of Taranaki.

66.—Wm. Bruce, exhibits a case of well stuffed Birds, but the specimens have not much interest.

Hawke's Bay.

168.—The collection of W. Colenso contains many objects of special

interest, amongst which may be mentioned Geological Specimens from the Southernmost Antarctic Land, obtained by the Erebus and Terror Expedition: these are very interesting and valuable. This cabinet also contains some curious and rare New Zealand Land-Shells, viz: 1 pair *Helix Busbyi*; 2 pairs *Bulimus Antipodarum* (?) and 1 pair *B. Fibratus*. (?) A specimen is shown, in spirits, of the large and scarce Guana-Lizard, *Hatterea Punctata*, caught at the Bay of Plenty in 1839; and a specimen of the large and scarce Wetu Punga of the Natives (*Deinacrida gigantea*, Col.) from the Bay of Islands. There is also an antique Bronze Bell, found by the exhibitor in the interior of the North Island in 1837, on which is an inscription in Tamil. The exhibitor states that it "had been in the hands of the Maoris for several generations." Several Moa bones viz: 2 Tarsi, 2 Tibiæ, and 2 Femora, found *in situ*, near Poverty Bay, in 1864, illustrate the general distribution of this gigantic bird over the Islands of New Zealand.

Wellington.

220.—George Fyffe exhibits a very remarkable specimen of a Moa's Egg, which is perhaps the most perfect specimen ever discovered. It is entire, with the exception of a portion of the lower side.

221.—H. F. Logan exhibits a very fine collection of Ferns, the specimens being of large size, well preserved, and carefully named and classified. This is undoubtedly one of the best collections of ferns in the Exhibition.

224.—C. W. Thatcher shows a very interesting collection of Marine and Land Shells, containing several rare varieties.

J. C. Crawford (266), and the Rev. Mr. Taylor (265), contribute valuable collections of Geological and Mineralogical Specimens, illustrating the geology of the Wellington Province.

Nelson.

331.—T. W. Lewthwaite exhibits samples of Coal from the Pakawau mine, concerning which full particulars are given in another report.*

332.—W. Wiesenhavern exhibits a model showing the stratification of the Pakawau Coal-field, taken from the shaft and borings on the Pakawau coal deposits, Collingwood. Unfortunately this model had been so much shaken as to disturb the arrangement of the materials. Mr. Wiesenhavern also sends Plumbago from the Pakawau mines.†

* Supplementary Report on Class I., Appendix A., Art. Coal.—ED.

† Supplementary Report on Class I., Appendix A., Art. Graphite.—ED.

Canterbury.

468.—W. L. Buller, F.L.S., sends two cases of Ornithological Specimens, containing illustrations of thirty varieties of New Zealand Birds, the whole of which are beautifully preserved and mounted, and may as a collection be considered one of the best in existence. It contains specimens of the following varieties:—

1. *Hieracidea Novæ Zelandiæ.*—Karewarewa-tara of the Natives; Sparrow Hawk of the Colonists.

2. *Hieracidea brunnea.*—New Zealand Falcon. Karearea, Kaiaia, Karewarewa of the Natives.

3. *Circus Gouldii.*—New Zealand Harrier. Kahu of the Natives.

4. *Athene Novæ Zelandiæ.*—New Zealand Owl. More-pork of the Colonists; Ruru, Koukou, Peho of the Natives.

5. *Prosthemadera Novæ Zelandiæ.*—Parson Bird of the Colonists; Tui Koko of the Natives.

6. *Anthornis melanura.*—Mocking Bird of the Colonists; Korimako, Makomako, Kohimako, Titimako, Kopara of the Natives.

7. *Pogonornis cincta* (male).—Hihipaka of the Natives.

8. *Pogonornis cincta* (female).—Hihimatakiore of the Natives.

9. *Mohoua albicilla.*—Popokate of the Natives. (North Island species).

10. *Mohoua ocrocephala.*—Popokatea of the Natives. (South Island species).

11. *Gerygone flaviventris.*—Riroriro, Piripiri, Pihipihi of the Natives.

12. *Zosterops* .—Tauhou, Kanohi-mowhiti, Poporohe of the Natives; Blight Bird of the Colonists.

13. *Petroica macrocephala* (female).—Ngirungiru of the Natives.

14. *Creadion carunculatus.*—Tieke, Purourou, Tiekerere of the Natives; Saddle Back of the Colonists.

15. *Platycercus auriceps.*—Northern Parrakeet. Kakariki of the Natives.

16. *Platycercus pacificus.*—Southern Parrakeet. Kakariki of the Natives.

17. *Nestor meridionalis.*—Whistling Parrot. Kaka of the Natives.

18. *Eudynamys taitensis.*—Long Tailed Cuckoo. Koekoea, Koheperoa of the Natives.

19. *Chrysococcyx lucidus.*—Shining Cuckoo. Warauroa, Pipiwarauroa of the Natives.

20. *Carpophaga Novæ Zelandiæ.*—Wood Pigeon. Kereru, Kuku, Kukupa of the Natives.

21. *Apteryx Mantellii.*—Kiwi of the Natives. (The range of this species is confined to the North Island).

22. *Charadrius xanthocheilus.*—New Zealand Dottrel. Tuturiwhatu of the Natives.

23. *Botaurus poicilopterus.*—New Zealand Bittern. Matuku, or Matukuhurepo of the Natives.

24. *Limosa Novæ Zelandiæ.*—New Zealand Plover. Kuaka of the Natives.

25. *Spatula variegata.*—Spoon Bill Duck of the Colonists; Wetawetangu of the Natives.

26. *Podiceps rufipectus.*—Little Grebe. Weiweia of the Natives.

27. *Spheniscus minor.*—Rock Penguin. Korora of the Natives.

28. ***Eudyptes pachyrhynchus.***—Yellow Crested Penguin. Tawaki of the Natives.

29. ***Procellaria Atlantica.***—Young (?); obtained on the West Coast of the Wellington Province.

30. ***Procellaria Cookii.***—Titi of the Natives.

31. Nest of the Fan-tailed Fly Catcher *(Rhipidura flabellifera).*

32. Nest of the Popokatea *(Mohoua albicilla).*

469, 470, 471.—Julius Haast, Ph.D., F.G.S., F.L.S., Knight of the Order of Francis Joseph of Austria, Member of the Imperial German Academy of Naturalists, &c. &c., Geologist of the Province of Canterbury, exhibits several cases of specimens of Rocks, Minerals, Fossils, Dried Plants, &c., collected by the exhibitor for the Provincial Government. The rocks and minerals are arranged geographically, and illustrate most fully the geological character of the Canterbury Province. An inspection of these specimens reveals the existence of numerous interesting and valuable substances. Few persons unacquainted with the geology of New Zealand would be prepared to find that many varieties of gems and precious stones exist in the Colony. In the collection under notice, there are specimens of several kinds of quartz gems, viz. *Chalcedony, Cornelian, Onyx, Opal, Amethyst, Jasper,* and *Garnet.* We find also specimens of Gold, Copper, Coal, Marble, and Iron ore, showing the wide distribution of valuable mineral and metalliferous deposits. The following is a list of the ores and minerals which are found to occur in the Province, taken from the Official Catalogue :—

a, Carboniferous, anthracitic, and bituminous Coal, River Kowai, Mount Harper, Clent Hills, &c. *b*, Secondary Coal, bituminous, River Grey, West Coast. *c*, Tertiary Brown Coal and Lignite in Tertiary formations, all over the Province, Malvern Hills, Mount Somers, Rakaia, Coal Creek, Rangitata, Northern Hinds, River Potts, Ashburton, Tenawai, &c. *Selenite*, in crystals on the surface of tertiary shale, Tenawai, &c. *Calcite* (calcareous spar), in cavities of volcanic, and in veins of sedimentary and metamorphic rocks, abundant all over the Province. *Travertine*, deposited from water having carbonate of lime in solution, Weka Pass. *Marble*, Malvern Hills. *Stalactite* and *Stalagmite*, caves of Mount Somers, &c. *Arragonite*, lining fissures and cavities of volcanic rocks, Banks' Peninsula. *Dolomite* (Magnesian limestone), Malvern Hills, interstratified with augitic greenstone. *Quartz*, in veins, in metamorphic and Palæozoic rocks, all over the Province. This mineral occurs also in the following varieties: —*Rock Crystal* and *Amethyst*, in amygdaloidal Trap, lining geodes, and cavities, Malvern Hills, Mount Somers, &c. *Milky Quartz*, in Granites, West Coast. *Prase*, small deposits in quartzose porphyritic Trachyte, Gawler's Downs. *Chalcedony*, in mammillary and botryoidal forms in amygdaloidal trap and quartzose trachytes; *Chrysoprase*, filling cavities; *Cornelian*, in small geodes and filling cavities; *Agate*, in geodes, often of very large size; *Flint*, filling cavities in the rocks; *Aventurine; Onyx*, some horizontally arranged chalcedonies in different colors showing a tendency to become onyx and sardonyx;—Malvern Hills, Clent

Hills, Mount Somers, &c. *Plasma*, filling fissures in tertiary quartzose trachytes, and occurring principally in Gawler's Downs. *Heliotrope*, in tertiary quartzose trachytes in small pieces, Snowy Peak, Malvern Hills. *Jasper, Basanite, Chert, Lydian Stone*, in different varieties, Malvern Hills, and elsewhere. *Silicified Wood* (petrified), in creeks in many localities where siliceous rocks are decomposing. *Ferruginous Quartz*, Gawler's Downs. *Semi-Opal and Opal*, filling small cavities in quartzose porphyritic trachyte, Malvern Hills and Mount Somers. *Quartz, in pseudomorphs*, imitative crystals of calcite, Snowy Peak, Malvern Hills, Gorge of Rakaia, Clent Hills, &c. *Hyalite*, in small masses lining cavities, Snowy Peak, Malvern Hills. *Apophyllite*, in amygdaloids, Rangitata. *Ichthyophthalmite* (zeolite), in felsite porphyry, Rangitata, Turn-again Point. *Serpentine*, in veins, Mount Cook Range, and some other localities in the Alps. *Diallage*, in Gabbro, Mount Torlesse Range, and Upper Rakaia. *Delessite*, in amygdaloids, Rangitata and Malvern Hills, &c. *Chlorite*, in laminæ, metamorphic schists, West Coast. *Nephrite* (greenstone of the Maoris), in rolled pieces on the beach of the West Coast. *Augite*, in trachydolerites and in fine twin crystals imbedded in agglomeratic tufa, Banks' Peninsula. *Hornblende*, in basaltic and doleritic rocks, Banks' Peninsula, Malvern Hills, Timaru, &c. *Hypersthene*, in hypersthenite, Malvern Hills. *Actinolite*, in metamorphic schist. *Chrysolite*, in grains of basaltic rocks, Banks' Peninsula. *Bole*, filling cavities in lava streams, Banks' Peninsula. *Pimelite*, filling cavities in amygdaloidal rocks, Malvern Hills, Clent Hills, &c. *Palagonite*, in angular fragments in palagonite tufas, Harper's Hills, near Selwyn, and Two Brothers, Ashburton. Another variety changing insensibly into a *Pitchopal*, inclosing leaves and stalks silicified, occurs in the same localities. *Heulandite* (Zeolite), in amygdaloidal traps, associated with felsite porphyries; and *Stilbite*, Turn-again Point, Rangitata. *Natrolite*, filling cavities in volcanic rocks, Banks' Peninsula. *Mesotype*, in needles, in fissures of volcanic rocks, and *Chabasite*, in trachytes, Banks' Peninsula. *Orthoclase* (potash felspar), in granites and other crystalline rocks at the West Coast, &c. *Sanidine*, or glassy felspar in trachytes and trachydolerites, Banks' Peninsula, and quartzose porphyritic trachytes, Malvern Hills. *Obsidian*, on the sides of trachytic dykes (selbands), Banks' Peninsula. *Pitchstone*, associated with quartzose porphyritic trachytes, Snowy Peak, Mount Somers. *Albite*, in dioritic porphyries, River Wilkin and Makarora Ranges. *Oligoclase* (soda felspar), in quartzose porphyritic trachytes, Mount Misery, Malvern Hills. *Labradorite*, felspar in lava streams, Banks' Peninsula. *Saussurite*, in Gabbro, Mount Torlesse. *Garnet*, (alamandine), in quartzose porphyritic trachites and pitchstones, Malvern Hills and Mount Somers. *Pistacite*, in diorite, Mount Torlesse Range. *Potash Mica* (muscovite), in granites and schists, West Coast, *Magnesia Mica* (Rubellan), in volcanic rocks, Banks' Peninsula. *Pearl Mica* (Margarite), in gneiss and metamorphic schists, West Coast. *Tourmaline*, in granite, Mosquito Hill, West Coast. *Marcasite* (white iron pyrites) in clays and tertiary rocks, in many localities. *Pyrites*, as mundic, in older palæozoic rocks as well as in brown coal and shale, ditto. *Mispikel*, in diorites, Malvern Hills. *Clay Iron Ore* and *Sand Iron Ore*, in tertiary strata, associated with brown coal and lignite. *Ilmenite*, titaniferous magnetic iron ore, in grains in melaphyres, Clent Hills. *Magnetic Iron Ore*, in grains and dolerite, Malvern Hills. *Green Earth*, in amygdaloidal trap, Malvern Hills, Ashburton, Rangitata, &c. *Spathic Iron* (carbonate of iron), found in large boulders coated with

black psilomelane, near the sources of the river Kowai, Mount Torlesse, is one of the finest iron ores in existence. ***Sphærosiderite***, in small crystals, or lining cavities of volcanic rocks, Banks' Peninsula, Malvern Hills. ***Vivianite***, coating cavities in melaphyres, Clent Hills. ***Hausmannite*** (red oxyde of manganese), coating joints in rocks and in rolled pieces in River Selwyn. ***Psilomelane***, in veins, Upper Waimakariri. ***Glaucolite*** (green sand), as small grains in the pepperstones, middle tertiary series, Malvern Hills, Coal Creek, Rangitata, Wega Pass, Ashburton, &c. ***Copper Pyrites***, in grains imbedded in quartzose schists, Moorhouse Range, &c. ***Green Carbonate of Copper***, in a rolled piece, from Mount Somers Range, River Stour. ***Gold***, south-eastern part of the Province near Waitaki, and south-western near Lake Wanaka, and western side of the main Range generally. ***Retinite***, in brown coal (fossil gum).

Case 1 contains *Plutonic* Metamorphic and Older Palæozoic Sedimentary Rocks, with the Ores they contain, arranged according to their geographical position.

Head Waters of River Molyneux, Metamorphic Rocks, No. 1 to 10.

Do. do. do. Trappæan Rocks, No. 11 to 16.

River Grey and West Coast—Plutonic Rocks, &c., and Gold, No. 1 to 23.

Head Waters of River Waitaki—Metamorphic and Sedimentary Rocks, No. 24 to 65. Amongst them, No. 35, specimen from highest point reached on Mount Cook.

Head Waters of River Rangitata—Metamorphic and Sedimentary Rocks, No. 66 to 84.

Head Waters of Rivers Ashburton and Hinds—Metamorphic and Sedimentary Rocks, No. 85 to 103.

Malvern Hills and Mount Torlesse Range—Metamorphic, Sedimentary, and Trappæan Rocks, No. 121 to 139.

Case 2 contains continuation of Metamorphic, Sedimentary, and Trappæan Rocks, from Malvern Hills and Mount Torlesse, No. 140 to 169.

Kowai coal measures, Malvern Hills, No. 170 to 189.

Carbonaceous beds of Clent Hill and Mount Harper, and Pudding Stone Valley, No. 190 to 198.

Tertiary beds, Malvern Hills, No. 199 to 230.

Tertiary beds of other parts of the Province, No. 231 to 249.

Case 3 contains Volcanic Zone of Malvern Hills, Older Quartzose Trachytic series, No. 261 to 307.

Amongst them some remarkably beautiful porphyritic trachytes with red garnets, as for instance Nos. 262, 263, 268.

Amongst the quartz varieties filling fissures or cavities in these rocks, very interesting specimens of heliotrope, chalcedony, jasper, rock crystal, &c.; also, some remarkable pseudomorphs of quartz, imitative of calcareous spar and casts; the former is well shown in No. 286, the latter by 305 and others.

Trachytic tufas and younger doleritic series, Malvern Hills, No. 311 to 332.

The Palagonite tufas, 319, 320, 321, are very remarkable, being the first—if we except those from the Galapagos Islands—which have been found in the southern hemisphere.

Small doleritic crater, N.E. corner of Malvern Hills, No. 333 to 336, the lava of which exhibits a well developed crystalline structure.

Older volcanic zone of Mount Somers, No. 337—363, quartzose, trachytes, pitchstones and tufas belonging to them. Although closely resembling the older

Malvern Hill beds in their mineralogical composition, they show some remarkable features; among the tufas, No. 350—ribboned tufa—is very beautiful.

Older volcanic zone of Gawler's Downs, resembling the foregoing in its principal constituents. Some interesting siliceous deposits occur here, which have inappropriately been called hornstone porphyries. The same rocks occur in Transylvania, where they are called palla, and are used for ornamental building purposes. Attention is also drawn to the palagonite tufas of the Two Brothers, No. 371, which are identical with those of Iceland.

Porphyritic zone, Rangitati, 388 to 396. Age probably secondary, and showing the true felsitic structure.

Case 4 contains some of the Rocks of the Isolated Volcanic System of Banks' Peninsula, No. 406 to 478. The specimens exhibited show at once that this zone consists not only of various centres of eruption, but also that the mineral constituents of the rocks are very varied. The oldest system by which the Calderas, the present harbours of that peninsula are formed, consist mostly of doleritic lavas, whilst the dykes by which they are traversed, are trachytic or trachy-doleritic. The Tunnel collection in Cases 9, 10, 11, will give an accurate insight into their character. In subsequent eruptions, by which the highest summits of the peninsula were formed, andesitic, or trachydoleritic lavas, are prominent, of which No. 457 shows the principal characteristics. Of the subsequent quartzose trachytic zone, No. 469 is a good specimen, whilst No 468 shows the mineralogical character of a doleritic lava stream. In Lyttelton harbour the latest eruptions were of a basaltic character, of which No. 462 is a specimen.

The same case contains a collection of some of the Building and Ornamental Stones of the Province, of which several are exhibited elsewhere in larger blocks by the owners of the quarries.

Case 5 contains Fossils. In order to have this collection more complete, some fossils of other parts of New Zealand have been added, so as to give, as far as our present knowledge extends, a tolerably accurate insight into the character of the palæontology of New Zealand.

Palæozoic fossils collected in Canterbury, No. 1 to 16. Annelides and tracks of annelides from beds of high age and undeterminable.

Silurian fossils, No. 17 to 22, from Mount Arthur, Nelson, according to Professor Fred. McCoy, identical with silurian fossils of Victoria.

Plant-beds, palæozoic (Devonian), No. 23 to 40, from Canterbury, still at present undescribed.

Spirifera-beds, upper Devonian, or lower carboniferous, Canterbury, No. 41 to 111; some of them identical with Victorian fossils; *Spirifera lineata* is a leading fossil.

Plant-beds, carboniferous, or great oolitic, No. 112 to 145. The discussion as to the age of these beds, which have several species in common with those in New South Wales, is not yet closed, Professor McCoy still adhering to his opinion that they are of the great oolitic age, whilst from stratigraphical evidence many other geologists pronounce them of an age as far back as the carboniferous period. Amongst the species peculiar to New Zealand the *Camptopteris Novæ Zelandiæ* is remarkable for its beauty.

Richmond sandstone—Trias, Nelson, No. 146 to 150. These fossils, confined hitherto to one locality in Nelson, have since been found in the S.E. part of Otago, by Dr. Hector.

Great Oolitic, Amuri, No. 146 to 159. The fossils of this zone are also identical with similar beds in Australia; beds of the same in the Waipara, Canterbury, contain the *Plesiosaurus Australis*, Owen, the specimen No. 159—teeth and vertebræ of saurians belong to the same period.

Cretaceous fossils, Northern Island, No. 160 to 162. The *Belemnites Aucklandicus*, 160, is characteristic of this zone.

Grey River coal measures, No. 163 to 188—(younger cretaceous?). The fossils hitherto collected in these important coal measures have not been yet sufficiently examined to determine their exact age.

Case 6 contains the Tertiary Fossils of Canterbury and of other localities, showing the universal distribution of identical species over both islands. The same case contains fine specimens of arragonite from Banks' Peninsula, and carbonate of iron from Mount Torlesse.

Case 7 contains Moa Bones of the following species:—*Dinornis robustus, didiformis elephantopus, casuarinus, struthioides*; *Palapterix ingens*, &c.

Case 8 contains Specimens from the Volcanic Zone of the Interior of the Northern Island, N.Z. Also, some fine fossils and minerals from Europe and elsewhere.

429*a* & 471.—Cases 9, 10, 11 contain 250 specimens from the different lava streams, beds of tufaceous deposits, dykes, &c. through which the Christchurch and Lyttelton Railway Tunnel has yet passed; the numbers on the specimens correspond with their proper position, as shown in the Sections hanging above them.

470.—Fifteen glass frames containing 200 Botanical Specimens of Alpine and Sub-Alpine vegetation of Canterbury. The examination of the interior of the Canterbury Province has brought to light various and beautiful new forms, illustrating the botany of the Province, very interesting even to an unscientific visitor.

Amongst the Ranunculaceæ, *R. Lyallii* and *Haastii* deserve especial notice. Amongst the Umbelliferæ, the *Ligusticum Haastii* and *L. piliferum*. Amongst the Compositæ, the *Celmisia coriacea, C. petiolata,* and *Haastia recurva.* Amongst the Cruciferæ, the *Notothlaspi rosulatum.* Amongst the Scrophularineæ, the *Veronica Haastii* and *V. epacridea.* Amongst the Boragineæ, the *Exarrhena macrantha,* and many others too numerous to be particularly specified.

The manner in which the botanical specimens are preserved and mounted called for the highest terms of admiration.

Otago.

681 *et seq.*—The extensive and highly interesting series of specimens, comprising the Museum of the Geological Survey Department of Otago, collected and arranged by the Provincial Geologist, James Hector, M.D., F.R.S.E., F.G.S., &c. &c., and his able assistants, Messrs. Hacket and Buchanan, undoubtedly was one of the most instructive and attractive features of the Exhibition. As representing the labors and research of about three years, much of which time has been devoted to the examination of localities previously either wholly unknown or only partially

explored, this Collection is invested with more than ordinary interest. Prior to the explorations of Dr. Hector, the greater part of the West Coast of Otago was a *terra incognita,* whilst absolutely nothing was known of its natural characteristics. Now, however, thanks to the researches of this gentleman, a large amount of most interesting and valuable information has been made known concerning this territory. We find what was popularly supposed to be an inhospitable, desolate, and unfruitful region, is endowed with rich resources, and possesses a vegetation equalling in luxuriance and variety the most favored portions of the Colony. New types of vegetable and animal life lend it a charm, which is heightened by the magnificence and grandeur of its scenery, and the peculiarity of its physical formation. The beautiful drawings from Nature executed by Dr. Hector and Mr. Buchanan, bring before us the botanical features and picturesque grandeur of this comparatively untrodden region; whilst in the Museum we get a glimpse at the mineralogical treasures which await development by the enterprise of colonists.

Though the illustrations concerning the West Coast may be considered a special feature of this Museum, yet not less interesting and important are the specimens of Rocks, Minerals, Fossils, Birds, Woods, and Plants, and other objects illustrating generally the Geology and Natural History of Otago, which make up the bulk of the exhibits. These are contained in fifteen cases and a wall shelf, and the total number of objects exhibited under separate labels is as follows :—

Rocks, Minerals, and Fossils	3768
Birds, Fishes, &c.	240
Woods, &c.	100
Dried Plants—Species, ...	650
Fibrous Materials, ...	150
Miscellaneous Objects, ...	100

besides Maps, Plans, Sections, and Sketches.

The following Synopsis of the contents of the Museum is taken from the Official Catalogue :—

681. I. Case, A.1.—Human Epoch. 60*—Maori Remains and Implements found at the ancient villages and camping places of the Natives, comprising :— Greenstone and Hornstone Adzes, Weapons and Ornaments; with these are found Bones of the Moa and other birds, along with Seal bones and shells of edible Mollusks, so mixed as to render it certain that at least some of the species of the Moa survived for a long period after the occupation of New Zealand by the Maoris; and that these now extinct birds were largely consumed

* Indicates number of specimens.—ED.

by them as food. No date can be indicated for the formation of these deposits, but in some cases, very considerable changes have taken place in the relative level of the land since the time at which they must have accumulated. Among this collection, some fine Moa bones and an Ancient Skull are exhibited by F. Fenwick, Esq., from a Maori camp at the mouth of the Otepopo River. This skull is remarkable, on account of the cylindrical shape of the front teeth. His Honor the Superintendent, J. H. Harris, also exhibits a Skull of a Mariori, from the Chatham Islands, and a curious form of a Mere Mere found along with it, for comparison with the Maori remains.

682. II. Case A.1. and Table —Turbary or Morass Deposits, Coast Deposits, Bones from Oamaru, Otepopo, Waikouaiti, Clutha, &c. Interior Deposits, Bones found on the surface of the ground, Bones found in alluvial deposits of the Great Basins, Moa Egg fragments, Supposed Crop Stones. The formation of these deposits may have been coeval with the first settlement of the island, but the abundant accumulation of Moa bones which they contain is not to be attributed to the direct influence of Man. The finest specimens of Moa Bones have been obtained from these deposits, as at Waikouaiti, where Mantell secured some of the most valuable now shown in the British Museum in London. From these deposits, in addition to the specimens which are the property of the Museum, and among which is a nearly complete skeleton, (*Dinornis struthioides*, Owen), found in the Botanic Gardens, Dunedin, is the splendid set of Leg Bones of the *Dinornis giganteus*, (Owen), exhibited by Mr. Payne (see No. 979 of the Catalogue), which was found when trenching a garden in the town of Oamaru. This Leg measures six feet in length, and the height of the complete skeleton must have been eleven and-a-half feet. In the alluvial deposits in the basin-like valleys of the interior of the Province, Moa Bones are very abundant, many fine specimens having been contributed to the collection by W. D. Murison, Esq., from the Maniototo Plains. From a similar deposit in the Manuherikia Plains, the most perfect skeleton of a Moa (*Dinornis robustus*, Owen), that has perhaps yet been obtained, was discovered in January, 1864. While some parts of this skeleton were quite as decayed as is usually the case, other parts seem to have been accidently preserved, in such a wonderful manner, that a portion of the skin with feathers, and also some of the ligaments of the bones still remained. This unique skeleton was transmitted to England, but it is represented in the Collection by a drawing of the restored form, one-sixth natural size, with detailed drawings of the various bones.

683. III. Case A.1. and Table.—Raised Beaches, Shells from Oamaru, Kaduku River Bones. The evidence of a comparatively recent elevation (geologically speaking) of the coast line, equal to about fifteen feet, is tolerably distinct along the whole of the East Coast of the Province, and, where circumstances have been favorable to their preservation, evidence of this is afforded by the occurrence of marine shells of existing species. A marked proof of the elevation of the land is afforded by the fact that the head of a large Porpoise was found in digging the trench round the Recreation Ground at the head of Dunedin harbor. This head was presented to the Museum by Mrs. E. B. Cargill.

684. IV. Case A 1. and Table.—Travertine and Fluviatile Deposits—Calcareous Deposits, including Plants, Clays, Infusorial Earth, Auriferous Gravels, Black Sands, &c.—25.

685. V. Case A.2.—Pleistocene Drift—(*a*) Glacier Deposits, Moraines, Silts, or Lōes. (*b*) Basin Deposits, Siliceous cements with leaves, 5; Silicified Woods, 7; Gravels, 6; Clays, 4; Bottom Cement with Gold, 3; Bottom Cement without visible Gold, 10—West Taieri, Manuherikia Plains, Idaburn Valley, Shotover. Kaolin Deposits, 1; Lignites, 8; Fossil Resin, Fossil Wood, Plastic Clay. This *Lignite Bearing Formation* is met with in all deep hollows on the surface of the schistoze rocks, where it has originally accumulated, and, from its position, been protected from the later denudation, at the time of the formation of the Newer Pleistocene Drifts.

686. VI. Case B.1.—Upper Marine Pliocene (?)—Tufas and Submarine Volcanic Strata of Oamaru Cape.—73.

(*a*) Hutchinson's Quarry	45.
(*b*) Maruwenua	14.
(*c*) Awomoko	16.
(*d*) Caversham and Green Island	11.
(*e*) Waikouaiti and Hampden	40.
(*f*) Shag Valley and Round Hill	8.
(*g*) Waireka Sandstone, with teeth, tusks and bones.	47.

687. VI. Case B.2.—Older Marine Strata—

Wakatipu Lake Limestone	50.
Waitaki Sandstone	36.

688. VII. Case A.2.—Miocene (?)—Great Brown Coal Series, or Upper Carbonaceous. Greensands and Limestones, with Marine Shells, Green Island. Esturine Beds, with Shells, Pomahaka. Limestones at the Molyneux. Upper Shag Point Beds passing insensibly into true Fluviatile Beds, with Brown Coal, Fire-clay, and Gravel Conglomerates. In the interior basins this series is directly overlaid by V b.—77.

689. VIII. Case A.2.—Eocene?—Ferruginous Shales with bands of Calcareous Ironstone, Shells, Cement-stones—Moeraki, Warepa, Mt. Hamilton, Saddle and Eyre Mountains; Upper West Coast Beds.—24.

690. IX. Case B.2.—Secondary or Lower Carbonaceous Rocks of Otago — Conglomerate and Shales, with Sandstone. Coal and Plants—Catlin's River, Waikawa, Tautuku. (Fossils—Inoceramus, Ammonites, Modiola, &c.—66.) Mataura to Mt. Hamilton 14; Shag Point, Dicotyledonous Leaves and Shells. West Coast Series.—67.

691. X. Case C.2.—Upper Palæozoic.—(*a*) Laminated Sandy Beds of Shale, with Plants and Tentaculites—Rogers' Run, Upper Mararoa, source of Greenstone River, Kahiku Ranges, Robinson's Saddle, Waitaki River, Dome Mountain. 64. (*b*) Diorite and Aphanite Slates, with Breccia Beds and Mineral Ground —Greenstone River, Eyre Mountains, Nuggets, Waitaki.—40. (*c*) Indurated Sandstone, of grey and green color, with Clay and Gruwacke Slates—Upper Von River, West side of Wakatipu Lake, Kakanui. —47. Mountain Limestone of do.—34.

692. XI. Case C.2.—Schistoze Rocks (Auriferous).—(*a*) Upper, Argillaceous, Arenaceous, and Calcareous, jointed and cleaved with little or no Quartz in Laminæ. Saddle Hill, Silver Stream, and up to the Maniototo Plains; Woolshed, and up to Gabriel's Gully; Wakatipu Lake and Moke Creek.—50

693. XI. Case D.1.—(*b*) Contorted Ripple Slates, Micaceous, Chloritic, Actinolite, and Pyritous Schists. Rough Ridge, Dunstan, Queenstown, Shotover.—93.

694. XI. Case D.2.—Series showing Chemical Induration, and the development of Mineral Crystals and Metallic Ores. Kawarau and Shotover, 26. Showing the development of Quartz in Laminæ and in Reefs. Waipori, Highlay, Arrow, and Shotover, 75. Copper Lodes; Moke Creek.—70.

695. XII. Case D.3.—Crystalline Rocks.—(*a*) Clay Slates, Mica Schists, Quartzite and newer Gneiss—probably a more highly metamorphosed state of the rocks, group XI. Mount Aspiring and Central Ranges, part of West Coast and the Bluff.—48. (*b*) Crystalline Rocks of the West Coast, Syenitic Gneiss, Statuary Marble, Gneiss with Garnets, Feldspathic and Micaceous Gneiss.—100.

696. XIII. Case C.1.—Newer Igneous Rocks.—Trachytic Porphyry, Portobello and the Peninsula; Trachytic Breccia, Port Chalmers and the Islands; Porphyry, or Trachydolerite, Flagstaff Hill; Spheroidal Clinkstone, Bell Hill; Laminated Clinkstone, Bellevue Hill and the Peninsula; Vesicular Basalt, Kaikorai; Porphyritic Basalt, Pine Hill and North-East Valley; Dolerite, Saddle Hill; Crystalline Greystone, Mount Charles; Compact Basalt, Elbow of the Pomahaka and Tokomairiro; Decomposed Igneous Rocks, Bole, Tufa, Dunedin, Anderson's Bay, Mount Charles, Moeraki, Oamaru, &c.—50.

697. XIV. Case C.1.—Older Igneous Rocks.—Diorite, Diabase, Aphanite, Hypersthene, Gabbro, Melaphyre, Serpentine, Dunite, Nephrite, Felstone, Porphyry—.28.

698. XV. Case C.2.—Plutonic Rocks.—Granite, Syenite, Eurite, Granite with Mica, Feldspathic Granite, Granite with Calcite.—66.

700. Table Case M.1.—Fossils illustrating the Palæontology of Otago, classified and named.—130.

701. M.2.—Collection representing the Economic Mineralogy and Simple Minerals of Otago. The following is a list of the minerals which have been ascertained to occur in the Province, and which are illustrated by this part of the collection and those of the Gold-fields Department.

Gold (native, nearly pure)	Moeraki.
Do. (alloy, with silver)	Imbedded as grains in Cinnabar.
Do. (alloyed with copper)	Auriferous drifts.
Cinnabar, sulphide of mercury	In alluvial deposits on the Obelisk ranges. It has more recently been found in the following localities:—Potter's Gully, Dunstan; Serpentine Valley, and Waipori.
3. Magnetite, magnetic oxide of iron ...	As black sand and rolled fragments in the alluvial drifts, as crystals and masses imbedded in the chlorite schist and gneiss, and other metamorphic rocks.
Hematite or Specular iron ore ... ... / Do., Red and Brown } Peroxyde of iron...	As iron sand and as veins in the crystalline rocks and schists west of the Lakes.
Glauconite, silicate of iron	In certain schists and in the middle tertiary or green sand series.
Iserine / Ilmanite } Titaniferous oxyde of iron ...	Black sands of various parts of the coast, and in some of the rivers.
Brookite, oxyde of Titanium	In trap at Otepopo.

Iron Pyrites, di-sulphide of iron	In schists, quartz veins, brown coal, and in very large cubes in chlorite schist at Maori Point, Shotover.
Marcasite, white do....	In brown coal series.
Mispikel, arsenical iron	In diorite and magnesian felstone, Milford Sound; also in alluvial drifts elsewhere.
Chromite, chromic iron	Milford Sound. The large block of nephrite, jade, or *Poenamu*, (Greenstone), which weighs 200 lbs., and was brought by Dr. Hector from Martin's Bay, on the West Coast, is speckled with this mineral in small grains. This interesting rock is therefore in all probability a local variety of the Dunite which forms the matrix of the chrome ore in Nelson. Both the Dunite and the Nephrite have a similar composition, viz. Olivine or Chrysolite, which is a common mineral in basaltic dykes.
Vivianite, Phosphate of iron	As crystals in Moa bones.
Siderite, Carbonate of iron	In cavities in the contorted schists.
Sphærosiderite	In basalts.
Clay iron ore	In brown coal series.
Manganite, Oxyde of Manganese	Veins in the schists, and as rolled fragments in the alluvial drifts at the Kawarau and Clutha.
Rhodonite, Silicate of Manganese	Do. do.
Stibite, Sulphide of Antimony	Arrow River.
Towanite, Sulphide of Copper	Moke Creek, in a lode.
Native Copper	Kawarau, Dunstan, Moke Creek, and Waitahuna.
Copper Pyrites, with iron	
Malachite, Green Carbonate of Copper ...	Waitaki, Pomahaka, Kakanui Mts? Moke Creek.
Silicate of Copper	Gneiss on the West Coast, Milford and Bligh's Sounds.
Cobalt Bloom, Oxyde of Cobalt	In schists and gneiss rocks on the West Coast.
Scheelite, Tungstate of Lime	Found by Caples on the Rees River, Wakatipu Lake.
Galena, Sulphide of Lead	In the Rough Ridge schists.
Topaz	Chatto Creek, Arrow River.
Quartz (crystallised)	In reefs, &c., in the schists.
Do. (amorphous)	Do. do.
Agate (mixture of amorphous and crystalline quartz)	In the Porphyritic rocks.

Jasper	In volcanic rocks at Moeraki and Otepopo.
Plasma (dark green, mixture of crystalline and amorphous quartz)	Do. do.
Chalcedony (white, do.)	Do. do.
Cornelian (red, do.)	Do. do.
Arrăgonite, do.	In cavities in Basaltic rocks.
Calcite, Carbonate of Lime	As marble and limestone, and as crystals in tertiary rocks.
Gypsum, Sulphate of Lime	Crystallised in the Moeraki clays. It is also exhibited in quantity and manufactured into Plaster of Paris, by the Waikouaiti Local Committee.
Chlorite, Silicate of Magnesia, Alumina, Iron, and Water	In schists, and amorphous in the vesicular basalt at Otago Heads and elsewhere.
Muscovite, Potash Mica	In schists and gneiss
Biotite, Magnesian Mica	West Coast.
Margarite, Pearl Mica	In schists and gneiss.
Lepidomelane, Black Mica	Do.
Garnet, ...	In the gneiss-granite and quartzite of the West Coast.
Epidote, Silicate of Alumina, Iron and Lime	In the gneiss-granite and granulites of the West Coast.
Phrenite	In the trap rocks of Moeraki and Otepopo.
Felspar, Silicate of Alumina and Potash ...	In all schists and crystalline and basaltic rocks.
Labradorite	In the Flagstaff Hill, trachydolerite.
Albite	In the diorites of the West Coast.
Tourmaline	In granite and gneiss of West Coast.
Lithia-mica	In marble of Thompson's Sound.
Lepidolite	West Coast gneiss.
Chrysolite, Silicate of Magnesia and Iron ...	Basalts of Saddle Hill and elsewhere.
Olivine, do. do. with water	Milford Sound.
Serpentine, do. do.	Do.
Nephrite, Jade or Maori Greenstone ...	Milford Sound; also, one rolled pebble in Silver Stream.
Asbestos, Fibrous Hornblende	Milford Sound.
Steatite, Silicate of Magnesia, Alumina, and Water	Milford Sound.
Schillerspar, do., with Iron Pyrites ...	West Coast.
Augite, Silicate Iron of Lime and Magnesia	Basalts around Dunedin.
Diallage, Silicate of Magnesia, Lime & Iron	Dioritic rocks on the West Coast.
Bronzite, do., variety of do.	Do.
Hypersthene	Do.

Hornblende, Silicate of Alumina, Lime, Magnesia, and Iron	Veins in syenitic and older trap rocks.
Tremolite, do., variety	In Milford Sound.
Chabasite, zeolite	In vesicular basalts near Dunedin.
Gmelinite	Do.
Natrolite	Do.
Mesotype	Do.
Ozokerite, fossil resin	In the brown coals.
Graphite, plumbago...	In the schists, and as scales of black lead in marble on the West Coast.
Kaolin, porcelain clay	Manuherikia Plains, Arrow River, &c.

733. Case N.—Minerals and Rocks of Otago, classified according to their chemical composition.

Crystalline Rocks, 84; Porphyritic, 60; Gneissoid, 77; Schistoze, 77=298.

734. Case O.—Type Collection of Minerals from Europe and other countries, 261.

Quartz and its varieties; Earthy Silicates; Salts of Lime, Baryta; Silver, Mercury, and Tin Ores; Titanium and Manganese Ores; Zinc, Cobalt, Antimony, and rarer minerals; Lead Ores; Copper Ores; Iron Minerals; Inflammables; Models of Crystalline Forms.

735. Cabinet P.—Containing Duplicates and Extra Specimens of Otago Rocks and Minerals; also 66 Specimens of Victorian Rocks, Minerals, and Auriferous Quartz Reefs; 100 Specimens of Typical Rocks and Fossils of England; Rocks of the Chatham Islands.

736. Table, with Rocks, illustrative of Sections and Maps, 170.

737. Samples of the Building Stones of Otago, with analyses attached. (See Supplementary Report on Class I., App. A.)

738. Ninety specimens of the Rocks and Minerals of Nelson.

739. A hundred specimens of the Rocks and Minerals of Wellington.

740. A large Skeleton of a Moa *(Dinornis struthioides)*, found in the Dunedin Botanic Gardens.

741. Is a wall case, K, containing sixty Specimens of the Woods of Otago, polished, with flowers and leaves, and with scientific, common, and native names attached: a very valuable and large collection, the best arranged in the Exhibition.

The following list of Trees and Shrubs found in the Province of Otago is intended to indicate the uses to which they may be applied, and to illustrate this collection:—

MEDICINAL, ORNAMENTAL AS A SHRUB TREE, AND IN CABINET WORK.

1. *Drimys axillaris (Pepper Tree)*.—A very handsome small tree, and more especially so when growing in the open, and at an altitude of 1000 feet. The foliage then becomes dense and reddish colored. Whole plant aromatic and stimulant. Wood very ornamental in cabinet work. Native name, *Horo Pito.*

FOOD FOR CATTLE, AND ORNAMENTAL.

2. *Melicytus ramiflorus*.—An angular-stemmed tree, ornamental, and nourishing as food for cattle. Native name, *Mahoe* or *Hinau-ini.*

ORNAMENTAL.

3. *Pittosporum tenuifolium (Black Mapau)*,—a very ornamental shrub when grown in the open, but when in bush either straggling or drawn up to a long bare stem with sparse foliage. It exudes a gum resin, which has not been examined. Native name, *Tarrata*.

4. *Pittosporum Eugenioides (White Mapau)*.—A very ornamental tree, more especially when in flower. Whole plant of a pale color, forming a striking contrast to the last, which is very dark. It also exudes a gum resin.

ORNAMENTAL AND FIBROUS.

5. *Plagianthus Betulinus* (*Ribbon Wood*).—A large tree, highly ornamental, especially when in flower. The bark which is thick and fibrous, might be employed in the manufacture of ropes or paper, but no quantity of it could be procured. (See specimens in Case L). This tree is already cultivated in England.

ORNAMENTAL AND FIBROUS.

6. *Plagianthus Lyallii*.—An ornamental shrub tree. Bark thick and fibrous. The wood is also fibrous, and the whole might be used for paper-making, if the expense of procuring it was not too great. (See Case L.)

7. *Hoheria populnea*.—Another of this family; also called Ribbon Wood round Dunedin. Bark fibrous. Whole tree ornamental, especially when in flower. Wood splits freely for shingles, but is not durable.

ORNAMENTAL AND USEFUL WOOD.

8. *Aristotelia racemosa* (*Moka*).—A very handsome, quick growing shrub tree. Wood very light, and white in color, and might be applied to the same purposes as that of the Lime tree in Britain. Its fruit is eaten. Makes finely marked veneer.

ORNAMENTAL.

9. *Pennantia Corymbosa*.—This is one of three distinct trees called Ribbon Woods by the settlers. When in flower they are all highly ornamental, when covered with white blossom. A specimen of Ribbon Wood was the only timber from Otago, shewn in the Exhibition of 1862, but of which species is unknown.

ORNAMENTAL WOOD, USEFUL; USEFUL IN THE ARTS, AND IN MEDICINE.

10. *Coriaria ruscifolia*, (*the Tree Tutu*).—It is an ornamental shrub, with poisonous seeds and leaves, probably on account of an alkaloid similar to strychnine. It has medicinal properties, and has been used in epilepsy with supposed success. The whole plant is very astringent, and might be used for tanning leather. Tannin Salts prepared from this plant are exhibited in Case M.2. The wood though soft, is beautifully marked in the grain, and might be introduced with effect in light cabinet work.*

ORNAMENTAL AND USEFUL AS A HEDGE.

11. *Discaria Toumatou* (*To-Matau-Kaurow*.)—If properly trained this shrub would form a handsome hedge that would be stronger than white thorn. The "Wild Irishman" of the Settlers.

* See Supplementary on Class I., App. A.: Arts. Tannin and Tutu Plant.—ED.

ORNAMENTAL, USEFUL FOR FENCING AND CABINET WORK.

12. *Carmichaelia Australis.*—This species, and also one or two others of this curious leafless genus of leguminous plants, would be highly ornamental in shrubberies. Some of them that have the habit of the common Broom, and have succulent twigs, are greedily eaten by horses, and might perhaps be introduced among furze copse as hill fodder.

13. *Sophora tetraptera*, var. *grandiflora* (*Kohwai*).—A splendid tree with laburnum-like flowers. There is a variety on the West Coast *(Sophora t. var. microphylla)*, with weeping branches and sparse flowers. Its wood is valuable for fencing, being highly durable. It is highly adapted for cabinet work.

ORNAMENTAL, USEFUL AS A DYE STUFF AND IN MEDICINE.

14. *Fuchsia excorticata.*—A very crooked but ornamental tree. The wood might be used as a Dye Stuff, if rasped up and bled in the usual way; and by using iron as a mordant various shades of purple may be produced, even to a dense black that makes good writing ink. Its juice, which is astringent, and agreeable, might perhaps yield an extract that would be useful in bowel complaints. Its fruit is pleasant, and forms the principal food of the Wood Pigeon.

ORNAMENTAL AND USEFUL FOR ALL DURABLE PURPOSES, ALSO FOR CABINET WORK.

15. *Metrosideros lucida* (*Ratā tree*).—A very ornamental tree, more especially when in flower, when the whole tree is covered with dark crimson blossoms. The timber of this tree is very valuable as a cabinet wood, and can be procured in quantity from the West Coast. It is also likely to come into demand for all purposes where durability and strength are required, such as for beams and knees in shipbuilding, bridges, and the like.

ORNAMENTAL.

16. *Metrosideros florida* (*Twining Rata*).—Similar in flower and leaf to the last, but forming a slender stem that climbs to the top of the tallest pine trees, and then spreads out as a mass of dense foliage, covered at certain seasons with scarlet blossoms.

ORNAMENTAL, USEFUL AS FUEL AND FENCING, ALSO MAY BE USED IN CABINET WORK AND BUILDING.

17. *Leptospermum ericoides* (*Manukā*).—A highly ornamental tree, more especially when less than twenty years old. It is largely used at present for fuel and fencing. The old timber, from its dark colored markings, might be used with advantage in cabinet work, and its great durability might recommend it for many other purposes.

ORNAMENTAL, AND USEFUL FOR FUEL AND FENCING.

18. *Leptospermum scoparium (Kilmog). Tea Tree of Cook.*—A highly ornamental shrub, sometimes large enough to be called a tree; bark papery. Both this and the former species have very astringent juices. These Leptosperma are known commonly as Manukas, and one of the species has been tested for its strength as a building timber, and found to bear a greater transverse strain than any of the Australian or other New Zealand woods.

ORNAMENTAL, AND USEFUL FOR AGRICULTURAL IMPLEMENTS.

19. *Carpodetus serratus (White Mapau).*—A very ornamental shrub tree, with variegated leaves and large white flowers in panicles. The flat, spreading character of its branches gives it a singular beauty. The wood of this tree is tough, and might be used in the manufacture of handles for agricultural implements.

ORNAMENTAL, AND USEFUL IN THE ARTS AND MANUFACTURES.

20. *Weinmannia racemosa (Karmai).*—An ornamental timber tree with handsome flowers. Its wood is close-grained and heavy, but rather brittle. This wood may, however, become useful for building purposes, being very similar to the wood Acer pseudo-Platanus and Fagus sylvatica, both British trees, and might be used for the same purposes—such as plane-making and other joiners' tools, block-cutting for paper, and calico printing, besides various kinds of turnery and wood-engraving.

ORNAMENTAL.

21. *Panax simplex.*—Ornamental shrub tree; leaves slightly aromatic when bruised.

22. *Panax Edgerleyi.*—Ornamental tree; leaves very fragrant. The bruised leaves of this plant, mixed with grease, form a favorite native perfume.

ORNAMENTAL—FOOD FOR CATTLE.

23. *Panax Colensqi.*—An ornamental tree; branches often umbellate; exudes a gum soluble in cold water, very similar to gum arabic, and may be used for adhesive purposes. This tree in the neighbourhood of Dunedin has large succulent leaves, which are eaten by cattle.

ORNAMENTAL.

24. *Schefflera digitata.*—An ornamental shrub tree, very common on the West Coast of Otago; grows near water.

25. *Panax crassifolium (Grass Tree or Lance wood).*—An ornamental tree with umbellate branches. It has a singularly graceful appearance in the young state, having long reflexed leaves, with serrated edges. The wood is close grained and tough, and makes good rails.

ORNAMENTAL AND USEFUL IN TURNERY.

26. *Coprosma linariifolia.*—An ornamental shrub tree; wood close grained and yellow; might be used in turnery.

ORNAMENTAL.

27. *Corokia Cotoneaster.*—A beautiful shrub, with dark foliage and yellow flowers.

28. *Olearia operina.*—A remarkable and highly ornamental shrub tree, with the leaves arranged in star fascicles, centred by large white flowers. It is limited to the sea side on the West Coast, south of Milford Sound to Preservation Inlet.

ORNAMENTAL AND USEFUL IN CABINET WORK.

29. *Olearia dentata.*—An ornamental shrub tree. Attains a considerable

size in the vicinity of Dunedin, often 18 inches in diameter. Wood close grained, and well marked for cabinet work. Would make strong hedges if trimmed. Resembles the holly in the leaves.

30. *Olearia avicenniæfolia.*—An ornamental shrub tree, flowers numerous, wood close grained, with yellow markings which render it desirable for cabinet work. Attains a diameter of 2 feet. Wood good for veneers, but often rotten in the centre.

ORNAMENTAL.

31. *Olearia Hectori.*—A very ornamental shrub tree. Grows on Mount Aspiring.

32. *Senecio rotundifolius.*—An ornamental shrub tree, leaves 3 to 7 inches long, thick and leathery—flowers in corymbs.

ORNAMENTAL AND USEFUL IN CABINET WORK.

33. *Dracophyllum longifolium.*—An ornamental shrub tree with long grassy leaves. There are several species of this not easily distinguished. The one in the vicinity of Dunedin attains a diameter of 10 to 12 inches. Wood is white, marked with satiny specks, and is adapted for cabinet work.

ORNAMENTAL AND USEFUL FOR FENCING, CABINET WORK—BARK ADAPTED FOR TANNING.

34. *Myrsine Urvillei* (*Red Mapau*).—An ornamental tree. Wood useful for rails in fencing; deep red; useful for cabinet work. Juice very astringent.

ORNAMENTAL AND USEFUL FOR INSIDE BUILDING WORK.

35 *Libocedrus Bidwillii* (*Cedar*).—A very ornamental tree; its wood light and clear grained, but only adapted for inside work, as it is not durable when exposed to the weather.

ORNAMENTAL AND USEFUL AS TIMBER.

36. *Podocarpus ferruginea* (*Matai*).—A large, ornamental, and useful timber tree, attaining a diameter of 3 to 4 feet. Wood close grained, hard, reddish, very durable; unequalled for barn or granary floors, useful also in bridges and fencing.

ORNAMENTAL AND USEFUL AS TIMBER.

37. *Podocarpus spicata* (*Miro*).—A large timber tree. Wood white, tough, durable. (These last two are both called Black Pine in Otago.)

ORNAMENTAL AND USEFUL AS BUILDING TIMBER.

38. *Podocarpus Totara.*—One of the largest timber trees in New Zealand, attaining a diameter of 10 feet; wood clean grained, and well adapted for carpenters' work; it splits freely, and is durable as fencing and shingles.

39. Portion of the Stump of a Totara tree, cut down by Captain Cook's party at Astronomer Point, Pickersgill Cove, Dusky Bay, in 1768—showing part of the wood to be still sound.

ORNAMENTAL.

40. *Podocarpus dacrydioides* (*White Pine*).—A large timber tree, attaining a diameter of 3 to 4 feet; wood white, tough, but in some districts almost useless. It could be applied to making staves. This is the Kahikatea. Grown on dry soil, it is good for the planks of small boats.

ORNAMENTAL AND USEFUL FOR ALL BUILDING PURPOSES AND FOR CABINET WORK.

41. *Dacrydium cupressinum (Red Pine or Rimu).*—A large timber tree, attaining the diameter of 3 to 4 feet; wood clear grained, reddish; useful for all building purposes. The wood of old trees is highly ornamental for cabinet work .The juices of these pines are agreeable to drink, and can be manufactured into spruce beer. (See Cook's Voyage).

USEFUL FOR CABINET WORK.

42. *Dacrydium cupressinum*, var. from West Coast.—Foliage erect, wood hard, close grained, yellowish, very heavy, ornamental.

ORNAMENTAL.

43. *Dacrydium Colensoi (Yellow Pine).*—A very ornamental little tree, and curious from having two kinds of leaves on the same branches.

44. *Dacrydium laxifolium.*—A small shrub tree.

ORNAMENTAL, AND BARK USED AS A DYE.

45. *Phyllocladus Alpinus* (*Toa-toa*).—A small tree, very ornamental; bark used for dyeing.

46. *Hedycarya dentata (Puri-puri kai fili).*—A shrub tree found only on the West Coast, growing as a shrub. Wood marked for a veneer.

ORNAMENTAL.

47. *Pimelea Guidia.*—A handsome shrub, rarely of any size: West Coast.

ORNAMENTAL, AND FOR CABINET WORK.

48. *Archeria Traversii.*—A shrub heath, very handsome when in flower; wood finely marked, hard, and dense.

49. *Elæocarpus dentatus (Pokako).*—A tree attaining three feet in diameter, not durable as timber, but very ornamental when young.

50. *Gaultheria rupestris.*—A very ornamental heath shrub.

ORNAMENTAL, USEFUL FOR CABINET WORK AND FIREWOOD.

51. *Griselinia lucida (Broad Leaf).*—One of the thickest trees in Otago. Wood splits freely, and is valuable for firewood. Some portions make handsome veneers.

ORNAMENTAL.

52. *Ascarina lucida.*—An ornamental shrub tree only found rarely on the West Coast.

NOTE.—*In addition to the above, the following notes are given in the Official Catalogue regarding trees and shrubs not represented in the collection.*

ORNAMENTAL AND USEFUL IN THE MANUFACTURE OF BASKETS.

Rhipogonum scandens.—A climbing shrub, reaching the tops of trees, very ornamental when in fruit, from the contrast of the bright red berries with the dark foliage and black stems. The stems are used when split for the manufacture of strong baskets. The root has been used in the same manner as sarsaparilla.

USEFUL AS PRODUCING A GUM, AND AS A MEDICINE, AND IN MANUFACTURE.

Phormium tenax.—Two varieties of this plant exist in Otago, one with dark red flowers and triangular erect capsules, strong broad erect leaves; the other with smaller flowers, inside petals greenish, capsules round 4 inches by 1 inch, twisted drooping leaves, narrower, finer fibre

Whatever may be the success in the invention of means to prepare the fibre for the manufacturer, it ought to be always borne in mind that the supply of raw material will be very soon dependent upon cultivation. It is a great mistake to suppose that an unlimited supply exists in the native state; and perhaps this is not to be regretted, as cultivation will improve the fibre, and those varieties possessing the finest fibre only will be cultivated.

It is understood that the Maoris cultivated this plant in the North Island, and it would be a subject worth enquiring into, in order to discover which is the best variety for producing a fine quality of fibre, and if there is any peculiarity in the system of cultivation. Also minute information is much required connected with the method and substances used in dyeing the flax with those brilliant colors, in which art the Maoris have excelled. The difficulty in producing good fast colors on vegetable fibre is well known, and many tedious and expensive processes are used to animalize (as it is termed) the vegetable fabrics, so as to enable the dyer to fix the colors. If we are to improve on the Maoris' method of dressing the flax, we should not be behind them in its adornment.

The gum of the flax is used for the same purposes as gum arabic. The root is purgative, and is also said to have the properties of sarsaparilla.

ORNAMENTAL AND FIBROUS.

Cordyline Australis (Ti or Cabbage tree).—A monocotyledonous tree, attaining a diameter of 3 feet, very ornamental; whole plant fibrous and might be made into paper. The juice of the roots and stems contains a small amount of sugar, and has been used for procuring alcohol.

Cordyline indivisa.—A West Coast tree. The fibre of the trunk is used by the Maoris in the manufacture of mats.

FIBROUS GRASSES.

Among the grasses in the genera *Triticum*, *Agrostis*, *Arundo*, and *Danthonia*, are several species well adapted for making paper. They are abundantly spread over the grassy hills of Otago, at altitudes of over 1000 feet. If the article should become one of export, the cost of conveyance to port would be heavy unless means were taken up-country to press it into bales. At some future time, however, machinery could be erected where water power is convenient, and the manufacture of paper could be carried on in the country.

ORNAMENTAL—TREE FERNS.

There are four arborescent ferns in the neighbourhood of Dunedin, and one other on the West Coast: the *Cyathea medullaris*, or edible tree-fern of the Maoris; the *Cyathea dealbata*, known by the milk-white color of the back of the fronds; the *Cyathea Smithii*, a green, smooth-fronded fern, sometimes found forked in two stems; the *Dicksonia squarrosa;* the *Dicksonia antarctica*, a dark green fern, sometimes forking in the stems. These five are all very ornamental, and might grow in the open air of Britain if planted in dark woods.

ORNAMENTAL.

Olearia Colensoi.—A very ornamental shrub tree, often found at an altitude of from 3,000 to 4,000 feet.

ORNAMENTAL AND USEFUL FOR CABINET WORK.

Olearia nitida.—An ornamental shrub tree, very showy in flower; found also at considerable altitudes. Wood close-grained with yellow markings.

ORNAMENTAL.

Olearia Cunninghamii.—An ornamental shrub tree, with very showy flowers; found abundantly on the West Coast.

Olearia nummularifolia.—A very ornamental shrub, leaves small, round, closely set.

Olearia virgata.—An ornamental shrub, leaves small, linear and in fascicles.

Olearia moschata.—An ornamental shrub, leaves small ovate, smells of musk.

ORNAMENTAL AND USEFUL FOR CABINET WORK.

Olearia Forsteri.—An ornamental shrub tree, flowers few; wood close-grained, with yellow markings, fit for cabinet work.

ORNAMENTAL AND USEFUL FOR THE APIARY.

Cassinia leptophylla.—An ornamental, hardy and evergreen shrub, leaves heath-like; the flowers supply an abundance of nectar for bees.

Cassinia Vauvilliersii.—An ornamental shrub, with larger coriaceous leaves than the last; useful also for bees.

ORNAMENTAL.

Senecio elaeagnifolius.—An ornamental shrub tree, leaves elliptico-oblong; flowers in racemes.

Senecio sciadophilus.—A climbing shrub, rambling habit.

Cyathodes acerosa.—An ornamental heath-like shrub; has two varieties, with white and red berries.

Veronica elliptica.—An ornamental shrub, East and West Coast; slim stems, sometimes eight to ten inches in diameter. There are one or two un-named species of the genus that would make beautiful additions to gardens, from their singular leafless-like appearance, the leaves being closely imbricated. As all these species are sub-Alpines, they would probably stand the British climate.

ORNAMENTAL AND MEDICINAL.

Veronica salicifolia (*New Zealand Willow*).—Is introduced at home. It is very hardy and ornamental. It is used by the Maoris as a tonic and purgative.

ORNAMENTAL AND USEFUL AS SHELTER.

Myoporum latum (*Kaiou*).—An ornamental shrub tree, which, from its speedy growth, is useful as a shelter. It grows best near the sea.

ORNAMENTAL AND USEFUL TIMBER TREES.

Fagus Menziesii (*Red Birch*).—A lofty timber tree, one of the most valuable in New Zealand, attaining a diameter of from two to three feet, yielding boards long enough for any purpose. It is durable and adapted for cabinet work. It is also well adapted for masts and oars, and perhaps no tree in New Zealand except the *Dammara*, or Kauri Pine, can be applied to so many useful pur-

poses. It is the only wood likely to be used for cooper's work in the country, excepting the *Fagus Solandri.*

Fagus fusca (*Black Birch*).—Is one of the largest timber trees in New Zealand; often attains a diameter of twelve feet. Wood clear-grained, splits freely, and may be as generally useful as the last.

ORNAMENTAL AND USEFUL FOR COOPER'S WORK.

Fagus Solandri (*White Birch*).—Is a large ornamental timber tree, attains a diameter of from three to five feet. Wood white, straight, tough, not durable under exposure. This wood is well adapted for cooper's work.*

BIRDS OF OTAGO.

Three large Cases of Specimens of the Birds of Otago, which as a collection may be considered the finest which has been hitherto made of New Zealand birds, are exhibited by Dr. Hector. The collection comprises 190 specimens, embracing 79 different species, of which 20 are from a collection presented by A. A. W. Lee, Esq. The whole are carefully preserved and mounted, the classified list having been prepared with the assistance of Walter Buller, Esq., F.L.S. Amongst the most interesting and rare specimens in this collection, may be mentioned a pair of the *Apteryx Australis*, male and female, which were killed in a hole under the root of a tree in Pickersgill Harbor, Dusky Bay, on Christmas Day, 1863. These birds are not uncommon in that quarter, but are very difficult to capture. They are of a dun chestnut brown color, with black streaks. The following is a list of the birds, specimens of which are placed in this collection:—

1. *Hieracidea brunnea.*—"Karearea," "Kaiaia," "Karewarewa" of the Natives (two specimens).—New Zealand Falcon.

2. *Circus Gouldii.*—Kahu of the Natives (four specimens, two adult and two immature birds). (N.B.—Elman's Falco Aurioculus is C. Gouldii in the hoary plumage of extreme age). New Zealand Harrier.

3. *Athene Novæ Zelandiæ.*—"Ku-kou," "Ruru Peho" of the Natives, (two specimens, male and female).

4. *Athene, n. sp.*—This specimen, belonging to H. Clapcott, Esq., was shot near Popotunoa. It is marked like *A. Novæ Zelandiæ*, but is brighter in color and grey on the throat, and more than twice the size.

5. *Halcyon vagans.*—"Kotare" or "Kotaretare" of the Natives (three specimens). New Zealand Kingfisher.

6. *Prosthemadera Novæ Zelandiæ.*—"Tui," "Koko" of the Natives (three specimens). Parson Bird.

7. *Anthornis melanura* —"Koho-i-mako," "Kohorimako," "Kopara," "Kokomako," "Korimako," "Korimoko," "Kohorimako" of Natives, (two specimens). Mocking, or Bell Bird.

8. *Acanthisitta chloris.*—"Piwauwau," "Tititipounamu" of the Natives (two specimens).

* Useful also as Tanning Material. See Supplementary Report on Cl. I. App. A. Art. Tannin.—ED.

8*a*. ***Zenicus Stokesii.***—"Matuhitui" of the Natives.

9. ***Mohoua ochrocephala.***—"Popokatea," "Mohoua" of the Natives (three specimens).

10. ***Sphenœacus Punctatus.***—"Mata," "Matata" of the Natives (two specimens, old and young).

11. *Gerygone flaviventris.*—"Pihipilai," "Piripiri" of the Natives (two specimens).

12. *Certhiparus Novæ Zelandiæ.*—"Toetoe," "Riro-riro," "Pipipi" of the Natives (two specimens).

13. *Zosterops* (?).—"Blight Bird," or "Wax-eye" of the Colonists; "Tauhou" or "Kanohi-mowhiti" of the Natives (three specimens).—A common bird in the South in certain seasons.

14. *Petroica Dieffenbachii.*—"Ngirungiru" of the Natives (two specimens, male and female).

15. *Petroica albifrons.*—"Totoara" or "Toutouwai" of the Natives (two specimens). New Zealand Robin.

16. *Anthus Novæ Zelandiæ.*—"Pihoihoi" of the Natives (two specimens).

17. *Turnagra crassirostris.*—"Pio-pio," "Koropio" of the Natives (one specimen). Thrush. Common in the woods in the south-west of Otago. Probably a distinct species.

18. *Rhipidura flabellifera.*—"Piwakawaka" of the Natives (two specimens).

19. *Rhipidura melanura.*—"Tiwaiwaka" of the Natives (one specimen).

20. *Callæas Wilsoni.*—"Kokako" of the Natives (two specimens). New Zealand Crow. Common in the woods of the south and west of Otago; but near Dunedin, only found on Mount Cargill.

21. *Creadion carunculatus.*—"Tieke," "Purourou," "Tiraweke" of the Natives (three specimens). Saddleback or Jack Bird.

21*a*. *Hirundo*, (?) Swallow.—Shot near Cape Farewell, March 1856, by A. A. W. Lee.

22. *Platycercus pacificus.*—"Powhaitere," "Kakariki" of the Natives (two specimens). Crimson-crested Paroquet.

23. *Platycercus auriceps.*—"Kahariki" of the Natives (two specimens). Yellow-crested Paroquet.

24. *Nestor meridionalis.*—"Kaka" of the Natives (five specimens, including a distinct West Coast variety).

25. *Strigops habroptilus.*—"Kakapo" of the Natives (two specimens). Common in all the Alpine forests, but rarely seen.

26. *Eudynamys taïtensis.*—"Koheperoa," "Koekoea," "Kohaperoa," "Kawekawea" of the Natives (three specimens, male, female, and young). Long-tailed Cuckoo.

27. *Chrysococcyx lucidus.*—"Pipiwaraupa," "Warauroa" of the Natives, (two specimens) Shiny Back Cuckoo.

28. *Carpophaga Novæ Zelandiæ.*—"Kuku," "Kukupa," "Kereru" of the Natives (one specimen). New Zealand Wood Pigeon.

29. *Coturnix Novæ Zelandiæ.*—"Koreka," "Koreke" of the Natives (one specimen). New Zealand Quail.

30. *Apteryx Australis.*—"Tokoeka" of the Natives (two specimens, male and female, and skeleton). Big Kiwi (*Roa, Haast*).

31. *Apteryx Owenii.*—"Kiwi," "Kiwi-iti" of the Natives (four specimens,

two adult and two young). The common Kiwi of the Middle Island, light mottled grey, and much resembling the Chinchilla fur.

32. *Charadrius obscurus.*—"Tuturiwhatu-pukunui" of the Natives (one specimen). Dottrel.

33. *Charadrius bicinctus.*—"Tuturiwhatu" of the Natives (three specimens).

34. *Charadrius frontalis.*—(Two specimens.) Chestnut-breasted Plover of the colonists.

34*a*. *Charadrius, sp.*—Scissor Bill.

35. *Thinornis Rossii.*—(Two specimens.)

36. *Hæmatopus longirostris.*—"Torea" of the Natives (two specimens). Oyster Catcher or Red Bill.

37. *Hæmatopus unicolor.*—"Torea" (two specimens).

38. *Ardea flavirostris.*—"Kotuku" of the Natives (two specimens). White Crane. Common in the Taieri and West Coast.

39. *Ardea matook.*—"Matook," "Matuku-wai-tai" of the Natives (two specimens). Blue Heron, shot at Martin's Bay, Sept. 1864.

40. *Botaurus poiciloptorus.*—"Matuku," "Matukuhurepo" of the Natives (four species—probably two species, lesser and greater). New Zealand Bittern.

41. *Limosa Novæ Zelandiæ.*—"Kuaka" of the Natives (four specimens). Grey Stilt.

42. *Ximantopus Novæ Zelandiæ.*—"Poaka" of the Natives (five specimens). Red-legged Stilt.

43. *Recurvirostra rubricollis.*—(One specimen, per Dr. Richardson). Avocet. Occasionally seen on the shores of the sea and inland lakes—very rare.

44. *Ocydromus Australis.*—"Weka" of the Natives (two specimens, and eggs). Woodhen or Maori Hen.

45. *Ocydromus brachypterus.*—"Moho-pango" of the Natives (two specimens). Common dark-colored Woodhen of the West Coast; feeds on shellfish.

46. *Rallus assimilis.*—"Moho-pereru," "Konini," "Katatai," "Mohokatatai" of the Natives (two specimens, adult male and young female). Striped Land-rail.

47. *Ortygometra affinis.*—"Koitareki" of the Natives (two specimens). Little Swamp-rail.

48. *Ortygometra tabuensis.*—"Putoto" of the Natives (two specimens).

49. *Porphyrio melanotus.*—"Pukeko," "Pakura" of the Natives (two specimens). Swamp Hen.

50. *Casarca variegata.*—"Putangi-tangi," "Putakitaki" of the Natives (three specimens, two drakes and one duck). Paradise Duck.

51. *Anas superciliosa.*—"Parera" of the Natives (two specimens). Grey Duck.

52. *Anas chlorotis.*—"Pateke" of the Natives (one specimen). Teal.

53. *Spatula variegata.*—"Tete" of the Natives (four specimens, two drakes and two ducks). Spoon-bill Duck.

54. *Hymenolaimus malacorhynchus.*—"Whio" of the Natives (two specimens, male and female). Blue Mountain Duck.

55. *Fuligula Novæ Zelandiæ.*—"Papango" of the Natives (three specimens, drake, duck, and variety). Black Widgeon.

56. *Nesonetta Aucklandica.*—"Metawetanga" of the Natives, (two specimens drake and duck.) Red Teal, common in the Sounds of the West Coast.

*

57 *Podiceps rufipectus.*—"Totokipio," "Weiweia" of the Natives (two specimens.) Little Grebe.

58. *Podiceps Hectori.*—(New species) named by Buller. Rufous Crested Grebe (five specimens; four adults, one chick and two eggs). Three of the specimens from the Kakapo Lake, West Coast, have white breasts. Two species from the Wakatip Lake are dark all over. These birds are common in retired lakes in the interior; a specimen killed in Lake Rotorua, Nelson, was in the collection of A. A. W. Lee, Esq.

59. *Spheniscus minor.*—"Korora" of the Natives (three specimens). Blue Penguin.

60. *Eudyptes Pachyrhyncus.*—"Tawaki" of the Natives (one specimen). Great Yellow-tipped Penguin.

61. *Eudyptes Antipodes.*—"Ho-i-ho" of the Natives (two specimens). Common Penguin.

62. *Pelecanoïdes Urinatrix.*—"Titi" of the Natives (two specimens).

N.B.—"Titi" general Native name for members of this family.

63. *Procellaria Æquinoctialis.*—(One specimen).

64. *Procellaria Capensis.*—Cape Pigeon (one specimen).

65. *Procellaria Cookii.*—"Titi" of the Natives (one specimen; per Mr. Lee.)

66. *Diomedea Exulans.*—"Toroa" of the Natives (two specimens; per Mr. Bathgate). Albatross.

66*a*. *Diomedea fuluginosa.*—(One specimen, and head of another, and skeleton).

66*b*. *Lestris* (*n. sp.*)—Larger than *Antarctica,* the "Plundering Gull" or Sea Hen of the Whalers, shot in Dusky Bay. Egg of same.

67. *Larus Antipodum.*—"Karoro" of the Natives (six specimens, four adults and two young).

68. *Larus Scopulinus.*—"Tara-punga" of the Natives (three specimens, two adults and one young bird; per Mr. Lee).

69. *Sterna (Sylochelidon) Strenuus.*—"Tara," general Native name for Terns (three specimens, showing seasonal changes of plumage).

70. *Sterna Frontalis.*—(Two specimens; two old birds and eggs).

71. *Sterna Antarctica.*—(Two specimens).

71*a*. *Sterna sp.?*

71*b*. *Sterna sp.?*

72. *Sula Serrator.*—"Takapu" of the Natives (one specimen).

73. *Graculus Carboïdes.*—"Kauau-tua-whenua" of the Natives (two specimens). Shag.

74. *Graculus Melanoleucus.*—(Two specimens).

75. *Graculus Varius.*—(Three specimens; male, female, and young).

76. *Graculus Punctatus.*—(One specimen; shot at Catlin's River, August, 1864—rare).

77. *Graculus Brevirostris.*—(Four specimens).

78. *Graculus Stictocephalus.*—(Two specimens).

745.—Is a Case containing a few specimens of the common Fishes and Marine Invertebrate Animals of Otago, exhibited in order to show the method of preparing and mounting such objects for a museum.

762 to 838.—A well-mounted and carefully classified collection of all

the known Ferns of Otago, comprising 73 species,* collected and arranged by Mr. J. Buchanan, who also exhibits sheets of the Mosses and Sea-weeds of Otago.

845 to 854.—Ten plates of Drawings of the Tertiary Fossils of Otago,† most beautifully executed by Mr. Buchanan; who also contributes a series of very interesting and well-executed views, illustrative of the geology of Otago, chiefly scenes on the West Coast.

856 *et seq.*—A series of valuable Geological Diagrams and Sections; afford a vast amount of valuable instruction concerning the geological features of Otago.

870.—Cabinet containing Herbarium of 650 species of plants, arranged according to Dr. Hooker's recently published Handbook of the Flora of New Zealand.

872.—Is an interesting relic connected with Captain Cook's visit in 1769, found by Dr. Hector. It is a portion of the stump of a Totara tree which there is every reason to believe was cut down by Capt. Cook's party in 1768, when he anchored in Pickersgill Cove, Dusky Bay, on the West Coast. A portion of this stump has been polished and placed among the specimens of wood in Case No. 741, which shows most perfect structure, notwithstanding that it has been cut for 93 years.

874.—Is a large and curious egg-shaped Boulder of Syenite from the Bluff, formed by the exfoliation of the decomposing rock.

877.—Is a Drawing of a remarkably fine Moa Skeleton, found some time since in this Province, and which is now in the Museum at York. This was the best preserved specimen that has ever been found, having the bones nearly complete, and having portions of skin, feathers, and ligaments still attached. It was of the species *Dinornis robustus*, and measured 7 feet 6 inches in height.

978.—Mr. Vincent Pyke, Secretary for the Otago Goldfields, exhibits a very interesting and instructive series of samples of the Auriferous Wash-dirts from the various Goldfields of Otago. Each sample is contained in a square glass case, affording a full examination of the peculiar character of the drifts, and of the conditions with which gold is found associated in the various localities.

Remains of the now extinct Moa are exhibited by Mark Jarvis (975); F. Fenwick, R. M. Payne (979); A. Webster (989); and Capt. J. Hamil-

* For List see Official Catalogue, p. 139, et seq.—ED.

† For List see Official Catalogue, p. 141, et seq.—ED.

ton (1102). The exhibit of Mr. Payne (979), is the leg of the *Dinornis giganteus*, found in trenching a garden at Oamaru.

980.—A. H. Ross exhibits some artistically stuffed Birds of Otago, as also James Lees, Port Chalmers (976).

981.—Is an interesting souvenir of Captain Cook's visit to New Zealand, viz., a Bronze Medal, one of those given by the great navigator to the Native Chiefs. It bears date 1772, and was found by the exhibitor, Peter Thomson, on the beach between Port Chalmers and Blueskin Bay.

984.—H. W. Meyer, Dunedin, exhibits samples of various ores of Australia.

982.– Is a most interesting collection of specimens of the Fossil and Recent Shells of Otago and Southland, principally by Charles Traill of Oamaru. It comprises 85 genera, represented by 195 species, and 846 specimens. It is rendered more complete by the shells obtained by Dr. Hector on the West Coast. The same case contains 100 specimens of the fossil shells from the Lower Pliocene Tertiary limestone at Oamaru, for comparison.

985.—The Alexandra District Committee exhibit a cleverly executed Model of the Township of Alexandra, showing the beach and terrace workings in the vicinity. This model was executed by E. T. Brown.

986.—The Clyde District Committee exhibit a Model of the German Claim on the Dunstan Goldfields, showing the method of working, and nature of the strata. The composition of the ground is illustrated by portions of the original materials. This model reflects great credit on its constructor, Theodore Rauft, who exhibits in another part of the Building a Model of the Lignite Workings at the Dunstan.

Very interesting Collections of Mineralogical and Geological specimens from the Wakatipu district, are exhibited by the Wakatipu District Committee (987), and by H. Manders (988), J. B. Bradshaw (991), W. C. Wright (992), R. Millett (993), J. G. Worthington (994), and J. B. Netherwood (995). Exhibits 991 to 995 indicate the calcareous arenaceous rocks of the secondary and lower tertiary formations. Specimens are also given of the different varieties of schistoze rock, and interesting specimens of copper ore, which is found in immense blocks at Moke Creek. It is much intermixed with quartz, and occurs in the form of copper pyrites, mixed with it is a sulphuret of copper and iron, and contains from eleven to twenty-two per cent. of copper.

1095.—An Obelisk, erected by the Commissioners for the New Zealand Exhibition, representing the whole of the gold exported from New

Zealand up to 31st December 1864, comprising 1,749,511 ounces troy, of the value of £6,771,318 sterling, of which

			ozs.	£
Auckland produced	...	...	9,524	29,857
Nelson ,,	...	...	78,428	303,909
Marlborough ,,	...	...	24,088	92,335
Canterbury ,,	...	...	23	91
Otago ,,	...	...	1,637,448	6,345,108
			1,749,511	£6,771,318*

This obelisk represented 103 cubic feet of solid gold.

Tasmania.

2843.—W. L. Crowther, M.D., Hobart Town, exhibits specimens of the leaves of Tasmanian timber trees.

Great Britain.

699.—Dr. Lauder Lindsay, Perth, has contributed a most valuable collection of specimens of the Geology of Northern Europe, as bearing on that of Otago. This collection was included in the exhibits of the Otago Museum, they having been presented to the Otago Museum by the Collector. It is accompanied with the following descriptive synopsis :—

"This Collection, consisting of 479 specimens, principally from the following localities,—Scotland, Island of Arran (which may be considered a Geological Epitome of Scotland), Edinburgh, Arthur's Seat, Calton Hill, Pentland, &c., Perth, Sidlaw and Grampians, Iceland, Greenland and the Faroe Islands, Norway, Sweden, Denmark, Germany (the Hartz), &c., comprising the following Rocks :—

"I. Volcanic Rocks.—(*a*) Ancient or Trappean, Basalt and Greenstone, Freestone and Claystone, Amygdaloid and Porphyry, Pitchstone, Tufas or Ash beds, Breccia and Conglomerate, &c. (*b*) Modern Lava, Scoria, Trachyte, Obsidian, Pumice, Tufas, &c.

"II. Plutonic Rocks.—Granite and Syenite.

"III.—Metamorphic Rocks.—Mica, Clay, Chlorite, and other Slates, including the Gold-bearing Slates of Scotland, Quartzite, Quartz, Conglomerates, Granular Limestone, &c.

"IV. Mineral Veins and Veinstones.—Ores of Iron, Copper, Manganese, Chrome, &c.; Spars of Baryta, Lime, Quartz, &c.

"V. Fossiliferous Rocks.—1. Recent Marl and Shell Clay: Siliceous, Sulphurous, and Calcareous Spring Deposits. 2. Tertiary: Foraminiferous Limestone of France, Lignites of Iceland and Germany. 3. Secondary: (*a*) Chalk, (*b*) Oolite, (*c*) Lias, (*d*) New Red Sandstone. 4. Primary: (*a*) Magnesian Limestone; (*b*) Carboniferous Sandstone—'Black Band,' Ironstones, Shales, and other rocks which accompany coal, Fossil Coniferæ, Mountain Limestone and its

* From Official Returns, the above is the exact quantity of gold exported to the above date.

Fossils; (*c*) Old Red Sandstone and its Conglomerates; (*d*) Silurian, Graptolite, and other Slates.

"*Note.*—The foregoing include many rocks and substances used, as—1st, Building: Sandstones, Flagstones, Limestones, Basalts, Granites, Slates; 2nd, Sculpture and the Decorative Arts: Marbles, Serpentines, Granites, Porphyries, Fossiliferous Limestones, Breccias, Alabaster; 3rd, Road Making: Basalts and Greenstones; 4th, Various Manufactures: Fuller's Earth, Baryta, Chrome, Plumbago, Gypsum, Iceland Spar, Pipeclay; 5th, Metallurgy: Metallic Ores and their Fluxes; 6th, Fuels: Coals and Lignites; 7th, Manure: Limestone, Chalk, and Marl; 8th, Jewellery: Jasper and Agate, &c."

746.—A case containing a Collection of Vegetable Fibres and Paper Materials, further reference to which is made in the Report on Class IV., Sub-Class C.

Europe.

3125.—M. Berkowitsch & Co., Vienna, exhibit a very beautifully arranged and mounted Herbary of Plants, cultivated from their seeds in the Austrian Empire.

Canada.

3150.—The Board of Trade, Quebec, exhibit a Series of interesting Specimens of the Woods of that Colony.

HONORARY CERTIFICATES.

59. J. KNIGHT, Auckland.—Valuable collection of the Mosses of New Zealand, exhibited by Sir George Grey, K.C.B.
60. STUDENTS OF ST. JOHN'S COLLEGE, Auckland:—Excellent collection of Ferns.
66. W. BRUCE, Auckland.—Stuffed Birds of New Zealand.
168. W. COLENSO, Hawke's Bay.—Geological Collection.
266. J. C. CRAWFORD, Wellington.—Geological Collection and Maps.
265. REV. R. TAYLOR, Wellington.—Geological Collection.
221. H. F. LOGAN, Wellington.—Excellent Collection of Ferns.
220. G. FYFFE, Wellington.—Moa's Egg.
224. C. W. THATCHER, Wellington.—Collection of New Zealand Shells.
469. JULIUS V. HAAST, Canterbury.—Geological and other Collections admirably illustrating the Physical Characters of the Province of Canterbury.
468. WALTER BULLER, Canterbury,—Admirably Preserved Illustrations of the Ornithology of New Zealand.
680. JAMES HECTOR.—Very complete Collections admirably illustrating the Geology and Natural History of Otago.
762. JOHN BUCHANAN.—Very Complete Herbarium, &c.
983. DISTRICT COMMITTEE, Waikouaiti.—Collection of Geological Specimens from the District.
677. F. FENWICK, Otepopo.—Collection of Moa Bones.
982. CHARLES TRAILL, Oamaru.—Fossil and Recent Shells of Southern N.Z.

1097 App. THEODORE RAUFT, Clyde.—Well Executed Model of the Clyde Lignite Workings.

985. E. T. BROWN, JUNR., per District Committee of Alexandra.—Model of Alexandra Township.

3125. M. BERKOWITSCH & Co., Vienna.—Instructive Herbary of Plants Grown in Austria.

699. W. LAUDER LINDSAY, Perth.—Geological and other Specimens.

2843. W. L. CROWTHER, Hobart Town.—Specimens of Leaves of Tasmanian Timber Trees.

CLASS XXX.

SUB-CLASSES *a* & *b*.—FURNITURE & UPHOLSTERY, INCLUDING PAPERHANGINGS AND GENERAL DECORATIONS.

JURORS.

R. FENWICK, *Chairman.*

CHAS. BEGG. | N. Y. A. WALES.

FURNITURE.

THE manufacture of Household Furniture, particularly of the decorative kind, may be said to be the application in some degree of Fine Art to articles of utility. The knowledge, thought, and care required to be exercised in the conception and production of articles of decorative furniture, are greater perhaps than many suppose who look at them in their complete state. The style and principle of construction have first to be studied; then the proportions of all the parts, the materials to be used, whether various woods, painting, inlaying, or carving. It will thus be seen that some knowledge of architecture is required to be united with the artistic labors of the sculptor, painter, and ornamentist, and the practical skill of the cabinet-maker, in the completion of an article of decorative furniture. It is only by the aid of the Fine Arts that the different branches of industry which have for their province household furniture and the decoration of public and private buildings, can achieve rapid improvement and obtain lasting success.

The principles which should guide the manufacturer of household furniture are so very clear that a simple exposition of them is sufficient to secure for them general assent. Household furniture, being destined to satisfy well-known wants, must above all things be useful and comfortable; in a word, must be perfectly adapted to the particular purpose for which each article is intended. It would be next to an absurdity to

sacrifice convenience to elegance. The richest carving and gilding could never make a bed good if it were so constructed that nobody could sleep in it. It is only when all the conditions of utility and convenience have been fully attended to, that the aid of Art begins to be called for. But then its task becomes simple. A piece of furniture well adapted to its object is easily adorned, and from its very usefulness derives often an elegance peculiarly its own.

The influence which the Great Exhibition of 1851 had in improving the taste and general character of English furniture and household decorations was immense, and in no department of industry was this made more apparent at the Exhibition in 1862, than that of Furniture and Upholstery. The Jurors hope that, in a similar degree, the result of the first New Zealand Exhibition will be the advancement, in taste, design, and workmanship, of the Cabinet-maker's Art in this Colony. Hitherto the cabinet-makers of New Zealand have almost confined their efforts in the production of ornamental furniture to a combination of the various woods which afford scope for the ingenuity and skill of the inlayer. But the few examples of carving in the Exhibition prove that a steady improvement is at work, and that local artists are desirous of emulating the higher and more finished productions of Europe.

In their inspection of the exhibits under this head, the Jury took into their consideration the following points—viz., general workmanship; design; illustration of the ornamental woods of the Colony; and decoration where resorted to. Speaking of the furniture exhibits generally, the Jury feel themselves justified in expressing praise of the taste, variety, and workmanship displayed. The numerous ornamental woods with which New Zealand abounds, afford great scope for the exercise of the higher efforts in cabinet-work, and for the display of decorative art in furniture. Nothing can surpass in beauty some of the woods employed in the specimens under examination, and no doubt the Exhibition will result in the more extended use of colonial woods for furniture. Of the woods chiefly used in New Zealand for cabinet-work may be mentioned Mottled Kauri, Rimu, Red and Black Pine, Rata, Rewa Rewa, Mapau, and the mottled and variegated portions which are occasionally met with in almost every variety of wood. The specimens exhibited by New Zealand cabinet-makers fully illustrated the adaptability of the Colonial woods for ornamental purposes. Judging from the specimens exhibited of furniture made from the woods of other countries, the New Zealand exhibits showed to advantage in respect of the beauty of material.

The following is a list of the various exhibits :—

Auckland.

70.—Corlett & Herbert show a large Book-case, chiefly remarkable for its ambitious decorations. The material used in its construction is Kauri Pine. The Book-case consists of a central recessed division, with projecting wings. A broad plinth divides the case into upper and lower compartments, the former comprising about three-fourths of the whole height of the work. The central compartment is inclosed with two panelled doors, with circular heads; and each wing contains a panelled door of similar construction and arrangement. Small pillars with capitals are placed at the sides of each compartment, and the whole work is surmounted by an entablature. As already stated, this exhibit is very elaborately decorated, the style adopted being Pompeian. But it is to be mentioned that the various designs and figures are not the original work of the Artist, the whole being simply what is known as "stencilling"; the finishing touches and shading being done by the hand. Although this fact considerably detracts from the value of the work, there can be no question that this style of decoration is admirably adapted for many purposes where first-class design and cheapness of execution are desirable. In the Book-case in question, the effect is excellent, and only a critical eye can detect the character of the decorations. The panels are filled in with a centre medallion, on which allegorical figures of Music, Science, History, and Literature are painted. Above and below these medallions are banners inscribed with the names of illustrious men in the various departments of Art, Science, and Literature. Appropriateness of style in the accessory decorations is a characteristic feature, and, where the finishing touches of the Artist have been required, they have been carefully and tastefully applied. The coloring is subdued and in good taste, and, where striking colors are used, they add to the effect without disturbing the general character of the design. The doors of the lower compartments are in the tesselated style of art, and the work is equally effective and artistic. In the matter of general construction and workmanship, the Book-case does not call for special mention, as evidently the whole production has been made subservient to the decorations of the painter.

71.—Edw. King exhibits a Book-case made by J. Mason of Auckland, from various ornamental woods the growth of that Province. There is nothing remarkable in the design of this exhibit, but the workmanship is good, and some of the woods employed are very beautiful. This book-case somewhat suffers in comparison with the other exhibits of furniture,

in that it has evidently been in use, thereby losing much of its original finish. The Jury have, however, no hesitation in reporting favorably upon it.

72.—Antone Seuffert sends a specimen of Inlaid Work in a small Table, the design and finish of which are first-class.*

73.—John Webster, Hokianga, exhibits a "Fancy Chair," cut from the base of some tree, the only specialité of which is the carved dolphins cut *in relievo* on each side.

74.—The Union Steam Saw, Moulding, Sash, and Door Company (Limited), send specimens of each kind of work in the above-mentioned class of articles, the workmanship of which is excellent, and illustrates in a high degree the perfection to which machinery of the kind used has been brought. No prices are affixed to the specimens, but it is understood they can be produced by machinery at a lower rate than by hand-labor.

37.—This exhibit, although catalogued in Class XII., comes more correctly under the present Class, being an inlaid Model of a Ship in full sail, exhibited by the owner, J. Cochrane. As a specimen of clever inlaid work, it is deserving of especial mention.

Hawke's Bay.

152 to 154.—John Dinwiddie exhibits three small Cases, containing various specimens of local productions. The woods employed are "Totara," "Mati," and "Mairi."

Wellington.

227.—William James exhibits an Inlaid Loo Table, which is unequalled in the Exhibition, either in design, variety of woods employed, or general beauty of appearance. The Jury have no hesitation in awarding the highest praise to the exhibitor for the great excellence of his workmanship.

229.—G. Turnbull, possessor, sends a small Circular Table made from a knot of totara. The wood in this instance resembles mottled walnut, and as a dark furniture wood is extremely beautiful. The Jury doubted whether this wood was totara, it so much resembled Amboyna wood of Africa.

* Unfortunately, by the fall of the building in which they were made, the whole of the articles expressly manufactured by Mr. Seuffert for the Exhibition were destroyed, and it was only by the kindness of the gentleman to whom the table exhibited belongs, that Mr. Seuffert was able to send any specimen of his art. This is the more to be regretted, as the articles destroyed were described by those who saw them as "very beautiful."—ED.

Canterbury.

472.—W. Howell, exhibits a small Work Table, composed of 25 varieties of New Zealand woods; the workmanship and general design of which are admirable.

Otago.

The exhibits from this Province are numerous, and as a whole highly creditable, whilst some of the articles are of the utmost merit.

996.—Robert Brown, Dunedin, exhibits a Work Table constructed of wood grown in the Province. The carved supports and feet of this little table are very well executed, and the whole character of the work reflects the highest credit on the manufacturer. As a work-table it should, however, have been made to open.

997.—James Callender, Taieri, sends a Wardrobe and Chairs, the workmanship of which is good and substantial.

998.—J. L. Godfrey, Dunedin, exhibits a number of specimens of Wood Carving, some of which are highly artistic in design, and entitled the exhibitor to very great praise. The workmanship is first-class, and there is an amount of finish about the various specimens which betrays the thoroughly experienced artist. Mr. Godfrey's exhibits consist of a Carved Mantel-Piece, of red pine; Carved Candelabra, a Carved Fire Screen, small Picture Frame, Carved Bracket, and Timepiece Cases, and a Carved group of Shells. The mantel-piece is not equal in point of design to the other specimens, the style of decoration being somewhat funereal in character. The woodwork is of red pine, and on the front is carved an urn, from which festoons of laurel are carried on each side. The pilasters are relieved by carvings of a simple design, but from the fact that the carved portions are painted black, and only relieved with gilding, the effect is sombre and hardly suited to domestic ornamentation. Of the fire-screen and wall-bracket, carved in the Grinling Gibbons style, the Jurors must speak in unqualified terms of praise. The character of the design is florid; flowers, fruit, and birds being grouped together in pleasing and artistic combination. An examination of the work showed its completeness of execution and finish, there being none of that roughness of detail which often marks wood-carvings. Mr. Godfrey's best efforts are undoubtedly the small group of shell-fish, and a small timepiece case and bracket. The group of shell-fish is admirably conceived, and as well executed. The most prominent figure is a crab, which is very life-like, and the same may be said of the various shells. This group is carved in Huon pine, and is a striking proof of the wide usefulness of

this valuable Tasmanian wood. The candelabra are more modest productions, and do not call for particular comment. The small time-piece case is the gem of this collection.

999.—John Gillies, Roslyn, Dunedin, exhibits a Cedar Wardrobe, with rounded corners, the workmanship, design, and finish of which are very good. The fittings are substantial, and the whole work bears evidence of being the production of a careful workman.

1000.—John Hill, Dunedin, sends several Articles of Furniture, comprising a Wardrobe, What-nots, a Loo Table, and Chairs. The Wardrobe is a substantial, well-made piece of furniture, constructed of red pine, the heads of the panels being inlaid with other woods. The What-nots are tastefully designed and well-finished, and the Loo Table is at once an example strongly illustrative of what patient manipulation can accomplish with the woods of Otago. It contains 2,500 pieces of wood of various kinds, inlaid in an ingenious and pleasing design. The two chairs have carved backs, but are chiefly remarkable for their beautiful tapestry work, of which a notice will be found under Class XXIV.

1001.—J. H. Harris, Dunedin, possessor, exhibits a Work-box composed of various colonial woods.

1002.—John Lemon, Oamaru, sends a Circular Table Top inlaid with native woods in a geometrical design. This piece of work bears evidence of much care and ingenuity, but is not otherwise noticeable.

1003.—Charles Meyer, Dunedin, contributes two Easy Chairs and Footstool of his manufacture, the workmanship of which is excellent, and the upholstery work first-class.

1004.—The Furniture exhibited by North and Scoular, deservedly occupies the place of honor amongst local exhibitors, and would bear a favorable comparison with the work of first-class English cabinet-makers. Their exhibits consist of a Book-Case, and Sideboard, made from a species of Fiji wood, the native name of which is *hake* or *yaka*, and which somewhat resembles the rimu of New Zealand. This wood, which has only recently been introduced into cabinet-work in this Colony, is a dark, close-grained compact furniture wood. It is peculiarly suitable for library furniture, and when used in connection with plate glass, as in these exhibits, the effect is most striking. The book-case displays many very desirable points of excellence in furniture of this description. Its design is tasteful and appropriate, and the decorative portions, whilst they relieve the appearance, do not impair the character of quietness and good taste which is the prevailing feature of the work. As a specimen of cabinet-

maker's handiwork, it is superior to any other in the Exhibition, and it is highly finished in every part. The Sideboard may be equally commended for its tasteful design and good workmanship.

1006.—W. J. Spiers, Moeraki, exhibits a Work Table of native woods, in a pretty inlaid design.

1007.—J. A. Steadman, Dunedin, exhibits a Small Table, the top of which is composed of engraved plate glass. This is a novel application of glass, and has a pleasing appearance. The risk of fracture, however, is a serious drawback to its extensive use in this manner. The glass is engraved in flowers or other appropriate design on the underneath side, the engraved portions being afterwards silvered; the effect of this being to make the design appear distinct and brilliant.

1009.—Telfer & Laurie, Dunedin, exhibit a Davenport and Loo Table made of red pine, hardly second, in point of workmanship, to anything of the class in the Exhibition.

1010.—Wallach Brothers, Dunedin, send a Loo Table and Easy Chair, manufactured in Victoria from woods grown in that Colony. As specimens of workmanship they are excellent, but the wood employed certainly does not equal some of the ornamental woods of New Zealand in beauty and general appearance. The carved supports of this table are creditable specimens of the wood-carver's art, but are too heavy in appearance for the size of the table. The Easy Chair shown by the same exhibitors deserves more especial mention.

Great Britain.

2978.—S. W. Silver & Co., London, exhibit a variety of Furniture, for Dining and Drawing Rooms, Library, Hall, and Bed Rooms. The articles in the highest degree realise the necessary conditions of excellence, being neat and appropriate in design, of good workmanship, and, where decoration is resorted to, it is effective and pleasing. The upholstery is very good. The suitability of some of the exhibits for furniture, where lightness, portability, and convenience are required, is particularly noticeable in some chairs, which, although fit for luxuriantly furnished apartments in point of appearance, can yet be folded and removed with all the readiness of a camp-stool.

HONORARY CERTIFICATES.

72. ANTONE SEUFFERT, Auckland.—For Inlaid Table of Superior Design and Workmanship.

227. WILLIAM JAMES, Wellington.—Inlaid Loo Table of Beautiful Design and Excellent Workmanship.

472. **Wm. Howell**, Canterbury.—Inlaid Work Table of Excellent Design and Workmanship.

998. **L. J. Godfrey**, Dunedin.—Wood Carvings, Group of Shells and Shell-fish.

999. **John Gillies**, Dunedin.—Cedar Wardrobe.

1004. **North & Scoular**, Dunedin.—Great Superiority in Design and Workmanship of Cabinet Work.

1009. **Telfer & Laurie**, Dunedin.—Davenport of Excellent Workmanship.

CLASS XXX.

SUB-CLASS *b*.—PAPERHANGINGS AND GENERAL DECORATIONS.

JURORS.

R. FENWICK, *Chairman.*

C. BEGG. | N. Y. A. WALES.

THERE are not many Colonial exhibitors in this sub-division. The specimens of Paperhangings are all of British manufacture, and the Colonial exhibits are almost exclusively confined to specimens of Painting and Graining as applied to domestic decoration.

474.—B. Button, Christchurch, exhibits twelve specimens of Painting on board, imitations of Woods and Marbles. They reflect the highest credit on the artist's skill, the imitation in each instance being very close to nature, and the general finish of the work all that could be desired.

1011.—David Milne, Dunedin, exhibits Paperhangings, Colors, and samples of Graining in imitation of Woods and Marbles. The specimens of graining are cleverly executed, and are such faithful copies of the materials they profess to imitate, as not to be readily distinguishable from them.

1012.—Thomas Lack, Dunedin, shows specimens of various styles of Letters used in Sign Painting, executed in a most artistic manner.

1013.—J. Ross & Co., Dunedin, show specimens of Imitations of Marble on paper for wall-hangings. These are executed by hand, and are very creditable productions.

1014.—Scanlan Brothers, Dunedin, exhibit samples of Graining and patterns of Paperhangings. The specimens of graining are a close imitation of the original materials.

1219.—W. Gilchrist, Invercargill, exhibits a Painted Table-top in imitation of various marbles, which, as a specimen of painting of this description, is the best in the Exhibition.

2981.—J. Woollans & Co., Marylebone, London, send samples of Paperhangings, which fully illustrate the vast improvement that has been made in the design and manufacture of this universal article of interior decoration.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

1219. W. GILCHRIST, Invercargill.—For Painting in imitation of Marbles.
474. B. BUTTON, Christchurch.—Graining.
1011. DAVID MILNE, Dunedin.—Graining in imitation of Woods.
2981. J. WOOLLANS & Co., London.—Paperhangings of good quality and design.

CLASS XXXI.

MANUFACTURES IN IRON, COPPER, &c., AND GENERAL HARDWARE.

JURORS.

R. OLIVER, *Chairman*.

ALEX. CAIRNS. | T. R. HACKET.

SUB-CLASS *a*.—IRON MANUFACTURES.

THE manufacture of wrought and cast Iron is one that is becoming of considerable importance in New Zealand. At Auckland and Dunedin are extensive workshops, where almost any ordinary class of iron-work can be produced, and which are quite capable of making and repairing steam machinery, whilst almost every other considerable port boasts a small foundry or millwright's shop. The blacksmith's forge is one of the earliest erected buildings in a new settlement, for without it the farmers would have no means of repairing their farm implements, or shoeing their horses. The large number of steam-vessels plying between the various ports of the Colony, are also constantly requiring repairs to their machinery and boilers, and except in extraordinary cases the foundries and workshops of the Colony are quite equal to any exigency. Engines for both land and marine purposes can be built in the Colony, and boilers of large construction repaired and made. Iron vessels have been put together and fitted with engines and boilers, and machinery requiring the most finished workmanship has been successfully constructed. The increased use of steam machinery in this Colony, makes it a matter of great importance that not only the necessary repairs can be effected here, but that if occasion require it, the machinery itself can be manufactured by local artisans. Judging from the specimens

of iron-work exhibited, both in wrought and cast iron, there is no reason to doubt the ability of the Colonial manufacturers to meet all ordinary demands. Some of the castings shown by them are of undoubted excellence, and other examples of the iron-worker's art display a degree of skill that could scarcely have been anticipated, considering the disadvantage which the Colonial manufacturer suffers through the want of the beautiful machines, tools, and appliances, which are to be found in the workshops of the old country. It may be that at some future day, when the development of those great agents of civilisation which at present lie latent in her mountains and scattered on the sea-shore, takes place—when the coal-pit and the foundry mark the advance of industry,—New Zealand may become the Vulcan of the Southern hemisphere, forging with her coal, her iron, and steel-sands, a prosperity, perhaps more enduring, if less attractive, than that produced by the labors of gold-seekers.

It will not be out of place if we append to this report a few figures to show the importation of unmanufactured and manufactured iron, during the four years ending Dec. 31, 1863.*

Imports of Iron, Ironmongery, and Machinery, exclusive of Agricultural Implements.

	1860.	1861.	1862.	1863.
Iron: Pig, Bar, &c..........	£20,618	£24,060	£81,172	£133,606
Ironmongery..................	59,274	67,248	78,481	143,950
Machinery.....................	14,421	30,221	43,211	73,772
Totals....................	£94,313	£121,529	£202,864	£351,328

The exhibitors of Iron Manufactures in Sub-Class *a*, were as follows:—

Canterbury.

475.—W. H. Barnes, a Register Stove of his own manufacture, a neat, useful article, and a clean good casting.

Otago.

1021.—A. Shaw & Co., Dunedin, a Galvanised Iron Tank.

1023.—R. Wilson & Co., New Zealand Iron Works, exhibit Models, and Castings of Ornamental Railing and Tablet for Grave Yard; the design of which is good and the casting clean and finished.

The following Otago exhibitors displayed imported goods:—

1016.—Baines & Oliver, Dunedin, a very excellent collection of British Manufactures in Iron and Steel, which, owing to Mr. Oliver's being on the Jury, could not be recommended for an Honorary Certificate.

1018.—D. Henderson, Dunedin, exhibits an extensive assortment of Register Grates, some of which are really handsome specimens of art

* The Import Returns for 1864 are still unpublished.—ED.

and manufacture. One Registered Stove in particular attracted the attention of the Jury, on account of its artistic character. The circular moulding consists of tesselated tiles or porcelain, of simple and pleasing design. Similar tiles are inlaid in the iron-work of the fender and ash-pan, the whole being relieved by a sparing use of ormolu. It is a handsome specimen of iron-work, and the Jury regretted the maker's name was not attached.

1019.—Wm. Kennedy, Dunedin, exhibits a variety of Portable Kerosene Cooking Stoves. On trial, these stoves were found to fully answer their intended purpose. They, however, emit an effluvium which would be objectionable in a dwelling-room, but they would be valuable where ordinary fuel and cooking appliances were not available.

1106.—Robert Henry & Co. show a Kitchen Range of good construction.

1022.—Stanford & Co. show a Kerosene Cooking Stove, similar to Mr. Kennedy's importations.

1020.—James Manning, Dunedin, exhibits a large "Economic Cooking Stove," of British manufacture.

Great Britain.

2982.—Carpenter & Tildesly, Willenhall, Staffordshire, exhibit a number of specimens of Locks and Lock Furniture, Currycombs, &c. The locks made by these exhibitors are unsurpassed for excellence of manufacture, and the reputation of the makers in this branch of ironmongery is world-wide.

2983.—Garfitt & Son, Sheffield, send samples of Shafts and Irons for Scythes, of good useful manufacture.

2989.—Watson, Gow & Co., Glasgow, exhibit Cooking Stoves and Grates, of various patterns.

SUB-CLASS *b*.—MANUFACTURES IN BRASS AND COPPER.

2988.—Thomas Lambert & Son, London, exhibit Patterns of Cocks and Valves for Gas, Water, and Steam, likewise of Wrought Iron Tubing.

SUB-CLASS *c*.—MANUFACTURES IN TIN, LEAD, ZINC, PEWTER, AND GENERAL BRAZIERY.

The Jury called in the assistance of the Jurors in Class XXXIII. in deciding on the merit of the exhibits of Plated Ware; whose report they have adopted.

——.—H. Loveridge & Co., Wolverhampton, send a variety of specimens of Japanned Ware, which for excellence of workmanship, and tasteful decoration, could not be surpassed.

2987.—Christopher Johnson, Sheffield (R. B. Martin & Co., Dunedin, agents), exhibits articles of Britannia Metal of excellent quality.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.

Sub-Class a.

1023. R. WILSON & Co., Dunedin.—Ornamental and other Castings.
1018. D. HENDERSON, Dunedin.—Register Stove of very superior design.
1019. W. KENNEDY, Dunedin.—Kerosene Stoves.
2982. CARPENTER & TILDESLY, Willenhall.—Excellent Lock Furniture.

Sub-Class b.

2988. THOS. LAMBERT & SON, London.—Gas, Water, and Steam Cocks and Valves, of good construction.

Sub-Class c.

2987. CHRISTOPHER JOHNSON, Sheffield.—Britannia Metal Goods.
—. H. LOVERIDGE & Co., Wolverhampton.—Japanned Ware of good quality and design.

Juror who was also an Exhibitor :—*

1016. R. OLIVER (Baines & Oliver), Dunedin.

* If an Exhibitor accepts the office of Juror, no Certificate can be awarded in the Class to which he is appointed, either to himself individually, or to the firm in which he may be a partner.—*Decisions on Points relating to the Exhibition*, 11 *(i)*.—ED.

CLASS XXXII.

CUTLERY AND EDGE TOOLS.

JURORS.

R. OLIVER, *Chairman.*

ALEX. CAIRNS. | T. R. HACKET.

THE display of articles in this Class was extensive, several British manufacturers of eminence having contributed specimens of their productions. There is a large consumption of steel goods in New Zealand, as cutlery for domestic and other purposes, edge and other tools for agriculturists, carpenters, sawyers, miners, &c. &c. The axe and the saw are the first pioneers in reclaiming to the purposes of colonisation the forests of a colony; the former we derive chiefly from America, the latter from England. It is a singular circumstance that no British manufacturer has yet been able to produce an axe equal, for the purposes of the bushman, to those made by Americans. American axes are everywhere in demand where heavy-timbered lands have to be cleared, whilst even the best attempts of the British axe manufacturer do not find favor. This is not owing to any inferiority in material, or deficient workmanship, but simply because the American axe combines in form, weight, and material, every essential point which the experience of the backwoodsman has suggested; whilst on the other hand the English axe is generally of such a shape as renders it vastly less suitable for the class of work for which implements of this kind are required. Remarks of a similar tendency may be applied to the mining tools of the respective makers. It is a fact, that as yet British manufacturers have not been able to compete with Americans in the class of tools employed by miners—such as picks and shovels; the American goods being lighter, better finished, and altogether more adapted for their intended purposes. On the other hand, the English manufac-

turers stand pre-eminent in other branches of steel manufacture. No saws, carpenters' tools, or cutlery generally, can compare with those of English make; and the various exhibits of these articles fully maintained the high reputation of the Sheffield and Staffordshire manufacturers.

The exhibitors of Cutlery and Edge Tools were:—

CUTLERY.

2997.—Joseph Rodgers & Sons, Sheffield.

2991.—Joseph Haywood & Co., Sheffield.

2992.—Christopher Johnston, Sheffield.

EDGE TOOLS, FILES, AND MECHANICS' TOOLS.

1028*a*. Mathieson & Son, Glasgow, per D. Henderson, Dunedin.

2983.—Garfitt & Sons, Sheffield.

2996.—Wm. Gilpin & Sons, Cannock. R. B. Martin & Co., Dunedin, agents.

2993.—Robert Sorby & Sons, Sheffield. R. B. Martin & Co., Dunedin, agents.

2994.—Ward & Payne, Sheffield. R. B. Martin & Co., Dunedin, agents.

2925.—Wm. Leggoe, Sheffield. R. B. Martin & Co., Dunedin, agents.

The exhibits of Cutlery were of an excellent and suitable character, and the Jury recommended in this Class J. Rodgers & Son, Sheffield (2997), for an Honorary Certificate.

In Edge Tools, &c., the Jury recommend the following awards:—

1028. —A. Mathieson & Son, Glasgow, for Edge Tools and Planes.

2993.—R. Sorby & Sons, Sheffield, for Saws, Augers, Adzes, Chisels, Scythes, and Sheep Shears.

2996.—W. Gilpin & Son, Cannock, for Augers and Tools. The Jury desire to draw special attention to a "Patent Screw Auger or Boring Bit," the advantages claimed for which by the patentee, and which were fully confirmed by a trial, are—"an immense saving of time and labor, do not split or shake the wood on entering or finishing a hole, they will bore at any angle, either across or with the grain of the wood, they will not follow knots or sun cracks, they are light, elastic, and not liable to break, and can be easily sharpened, and are particularly adapted for morticing," &c.

HONORARY CERTIFICATES.

2997. JOSEPH RODGERS & SONS, Sheffield.—For Cutlery of superior quality.

1028*a*. ALEX. MATHIESON & SON, Glasgow.—Planes and other Edge Tools of superior quality.

2993. ROBT. SORBY & SONS, Sheffield.—Hand Tools of superior quality.

2996. WM. GILPIN & SON, Cannock.—Patent Screw Auger, and other Tools.

CLASS XXXIII.

WORKS IN PRECIOUS METALS, AND THEIR IMITATIONS, AND JEWELRY.

JURORS.

A. BEVERLEY, *Chairman.* | EDWIN JONES.

THIS Class includes the works of the Jeweller, Goldsmith, and Silversmith, as well as plated ware. From the value and beauty of the materials employed, these works are very attractive and interesting, but the richness of the material should not exclusively occupy the attention, which should be chiefly directed to the perfection of the workmanship and the art displayed in the design and its execution. In too many instances it appears to be the impression of the gold or silversmith that the costliness of the material he employs will cover any defects in workmanship or design, and thus we have often presented to our notice objects wrought in the precious metals, the design of which is in utter violation of the principles of art and execution, and which in the baser metals would be considered bad.

Silver and gold from their great beauty and the ease with which they can be worked, offer fitting material for the noblest efforts of the modeller and graver, and the costliness of the material which lends additional charm to true works of art, is a mere element of vulgar display in ill executed and unworthy designs.

Much of the beauty of jewelry depends upon the skill of the lapidary in cutting and polishing the stone or gem employed. The jeweller has to set the stone to advantage, in doing which the utmost delicacy, combined with solidity of workmanship, is necessary.

In making their examination of the various exhibits in this Class, the Jury did not attempt to criticise severely the works of local manufac-

turers, who necessarily are deprived of many of the advantages which are to be found in large and well organised workshops. The Jury observed that whilst in a particular class of work the local manufacturers display considerable efficiency, they have yet much to learn in the higher branches of the goldsmith's art, before they can produce any great work. Several ambitious specimens are exhibited, which although they are creditable to the industry and intention of the maker, are very deficient in many essential points. On the other hand, in other branches great excellence is manifested, and there are chains, simple brooches, and other articles which reflect very great credit on the manufacturer. Greater attention to the principles of art and design is above all things necessary, to enable our local manufacturers to emulate the efforts of the accomplished artists of Europe.

The importations of Jewelry and Watches into New Zealand, in 1863, were valued at £48,000.*

The following is a list of the exhibits:—

Auckland.

75.—T. A. Fairs, pos. Ancient Silver Chalice, shows chasing of a high order.

76.—J. H. Watt, pos. St. Andrew's Cup, carved in Cocoa-nut Shell, silver mounted. The mounting possesses no merit.

Otago.

1029.—J. Bernstein, Dunedin, manu. This Case contains Watch Chains and Bracelets, all of New Zealand manufacture, which display great taste and skill in their construction. Most of the chains are both in beauty and finish quite equal to those of English manufacture. The bracelet bands are of woven gold chain, and though not quite equal to the chains in finish, are still very creditable, and the mountings, formed of leaves and flowers, with diamonds and other gems, are very tasteful, and are finished in the best style.

1030.—Goodwin & Barlow, Clyde, manu. The exhibits in this Case show the Gold as it appears in the different stages of manufacture into articles of jewelry—and this appears to be their chief merit. The finished articles, with one or two exceptions, are not equal to some of the others of the same kind in the Exhibition. Every department of the work appears to be done by themselves.

* Returns for 1864 not obtainable when this sheet was revised, but if received in time, will be included, with all other Import Returns, in the Appendix.—ED.

1031.—H. Houghton, Dunedin, pos. Silver Presentation Plate, as Commissioner for Canada at the Great Exhibition, 1851, of foreign manufacture.

1032.—A. Myers, Dunedin, manu. The principal exhibit in this Case is a large Silver Cup of local manufacture. The cup itself has various New Zealand devices, including the front of the Exhibition Building chased on it, and is supported on the figure of a Cabbage Tree, surrounded with Native Flax, and surmounted with the figure of a Moa bird. The design and finish of the cup are both good, but the modelling of the figures by no means excellent. Two Rings, with figures of the Exhibition Building, are fair specimens of local workmanship. Two Colonial-made Brooches show design.

1033.—N. Salomon, Dunedin, manu. and imp. This Case contains the most extensive and valuable assortment of its kind in the Exhibition. The articles are principally Foreign, some Colonial, and a few New Zealand manufactures. The most prominent among the latter is a Gold Inkstand, which demands attention from its size and costliness—and it is with regret that the Jurors have concluded that, owing to the want of apparent design and absence of skill displayed in the execution of the figures, they do not feel justified in considering its merits to exceed that of a courageous attempt to grapple with considerable difficulties. A Gold Bracelet, of New Zealand manufacture, is of the same description and quality as those in Mr. Bernstein's Case. The English Jewelry displayed in this Case is of great beauty and variety, and the Diamond and Gem Rings, and Brooch Sets in particular, are of great value and the finest workmanship. A Gold and Enamel Snuff Box (French manufacture), shows design and execution of a high order. The Silver Goods are also in great variety, and well executed. The Cricketers' Inkstand is deserving of attention.

1034.—J. T. Thomson, Dunedin, pos., Silver Presentation Plate, foreign device; modelling of the figures excellent.

1035.—G. Young, Dunedin, imp. and manu. The exhibits in this Case are partly English and partly New Zealand manufacture; the English jewelry is tastefully selected though not of great value. The New Zealand Chains with English animal seals attached, are of the same description and quality as those in Mr. Bernstein's Case: the same may be said of the Bracelets. The Brooches of New Zealand manufacture are excellent in design and execution; particularly the Bridal Brooch with Turquoise, cut in the form of joined hands.

1036.—V. Pyke, Dunedin, pos., Silver Masonic Tools.

1037.—J. Brownhill, Port Chalmers, pos., Australian Topaz Brooch of Colonial manufacture.

South Australia.

2435.—M. Wendt, Adelaide, manu., Silver Epergne, Inkstand, Claret Jug, and Tazzas of Colonial manufacture. The general design, modelling, and execution of the figures in these exhibits are excellent, and display a skill in modelling in metal after nature, far superior to anything else in the Exhibition, excepting foreign productions, and approaching closely even to them. They are interesting on account of the objects represented being characteristic of Australia, and most of them peculiar to it. The silver-mounted Emu's Eggs and Malachite Brooches, though not so elaborate as the other pieces, are good specimens of workmanship.

PLATED WARES.

The exhibits of Electro-plated and other descriptions of Plated Goods were very excellent, and included specimens of the most recent designs of eminent British manufacturers.

1017.—Day & Mieville, Dunedin, imp., exhibited a handsome collection, remarkable for the high quality and design of the various articles.

1106.—R. Henry & Co., Dunedin, also exhibited an excellent assortment of Plated Goods.

HONORARY CERTIFICATES.

1017. DAY & MIEVILLE, Dunedin.—Superior Plated Goods.

1029. JACOB BERNSTEIN, Dunedin.—Watch Chains of excellent design and workmanship.

1033. N. SALOMON, Dunedin.—Superior Jewelry.

2435. M. WENDT, Adelaide.—Works in Silver, &c., of excellent design and workmanship.

CLASS XXXIV.

GLASS.*

IN THE YEAR 1863,† the imports of Glass into New Zealand reached the value of £51,453. Nor will this be the total value of all the Glass imported, as it does not include the Bottles and other Glass Vessels in which liquids are imported.

Although, as a Cathedral is now being built at Christchurch for the Church of England, and another is about to be commenced at Dunedin for the Roman Catholics, we may soon expect to see painted glass employed for decorative purposes, as yet, beyond a little colored glass, none has hitherto been used in New Zealand; and it is not matter for surprise that none is in the Exhibition. But of glass for household use there is a very fair display, all of which is, of course, imported.

1038.—Matheson & Campbell, Dunedin, send some very handsome specimens of Glass-ware.

1018.—Scanlan Bros. & Co., Dunedin, show good samples of Glass for building purposes.

1052.—J. A. Steadman & Co. exhibit some very beautiful specimens of Engraved Glass, including a handsome Jug and Goblets, and a Table Top, mentioned in Class XXX., which is a very fair specimen of the engraver's art.‡

2997*a*. W. P. & G. Phillips, London. Specimens of Glassware, cut, moulded, and engraved, of general merit. Though not makers, Messrs. W. P. & G. Phillips were awarded a Medal at the International Exhibition, 1862.

2988.—James Green, London, (R. B. Martin & Co., Dunedin, agents), exhibits Glass Chandeliers, Lustres, and Cut and Engraved Table Glass, in considerable variety, as well as a collection of Common Cut and Pressed

---

* In this Class, the Jurors appointed not having met, the Awards were made by the Commissioners.

† Not yet published for 1864.—ED.

‡ The Commissioners greatly regret that, through the heedless movements of some unknown visitors, this beautiful Table was destroyed. Fortunately it is the only instance in which any exhibit was materially injured.—ED.

Glass. This exhibitor also received a Medal at the International Exhibition, 1862, for the general excellence of the cutting and engraving of his Table Glass, &c., &c., and some of his exhibits here do him great credit.

The most important exhibit of glass was undoubtedly that in the "Dioptric Lighthouse Apparatus" (612), exhibited by Mr. Balfour, for the Provincial Government of Otago. This splendid apparatus has been already fully reported on in Class XIII.; but, although not coming under this Class, it is impossible to report even in the most cursory manner on the exhibits of glass, without awarding to Messrs. Chance Brothers, Birmingham, the manufacturers, that meed of praise which is the just tribute not alone to their manufacturing skill, which the experts at the International Exhibition 1862, reported "placed them in most respects without a rival," but also the eminent scientific attainments which have enabled them to use the splendid material they manufacture but as the stepping-stone to higher honors.

HONORARY CERTIFICATES.

1108. SCANLAN BROS., Dunedin.—For Glassware.
2997*a*. W. P. & G. PHILLIPS, London.—For Glassware of superior manufacture.
2998. JAMES GREEN, London.—For Glassware.

CLASS XXXV.

POTTERY.

CERAMIC Manufactures are applied to such a vast variety of important purposes, that the greatest encouragement should be given to the cultivation of the potter's art in this Colony, where, in addition to clays suitable for the commoner branches of pottery, we have some of the valuable earths and clays adapted to the manufacture of porcelain, and the finer kinds of domestic ware. The use of earthenware for sanitary purposes and applications has largely increased of late years, and it is rapidly superseding the materials formerly employed. The consumption of Earthen and China ware in New Zealand is extensive, these articles having been imported to the amount of £42,077 in 1863.*

Pottery may be divided into three main classes, viz. :—

1. Building Materials—bricks and tiles, &c.
2. Sanitary Appliances—drain pipes, &c.
3. Domestic Pottery and Chinaware, &c.

The manufacture of bricks and tiles may be considered the lowest application of the potter's art, and yet there are many very important points necessary to be observed in order to produce a durable and well-made article. When we consider how necessary it is to ensure as much as possible the longevity of our dwelling-houses and public buildings, the durability of the materials used in their construction becomes a matter of serious import. It is all the more necessary that the attention of builders and brick-manufacturers should be directed to securing a thoroughly good article, because it is a well-known fact, that with very few exceptions, the bricks commonly used in building are imperfectly made, badly tempered, and badly burned. It is no uncommon circumstance to see a brick wall of comparatively recent construction crumbling away, owing to the rapid decay of the brickwork. In ancient times the manufacture of bricks was

* Returns for 1864 not yet published.—ED.

a subject of peculiar care to the ruling powers, who regulated the manufacture, and secured its efficiency. The great durability of the bricks thus made is well-known.

In modern days the rage for cheapness has resulted in the application of machinery to the various processes, and the laborious hand-labor required in the tempering and moulding is being fast superseded by ingenious mechanical contrivances. In this Colony the prevailing mode of manufacture is by manual labor, except in a few instances where machinery has been introduced. One alleged reason for the inferiority of Colonial-made bricks is that the clay is not allowed to lie exposed sufficiently long to the action of the atmosphere before using; but this is as great a fallacy as the supposed necessity for letting land lie fallow. The great points to be observed are the selection of proper clay, thorough tempering, and thorough burning.

The various argillaceous earths used in brick-making are generally mixed with some other substance, being for the most part unfit to be used alone. Some are almost pure clay or alumina, and are strong and exceedingly plastic, but cannot be dried without splitting. Others, being light sandy loam or clays, are too loose to be made into bricks without the admixture of lime as a flux, to bind the materials together. Others again, are natural compounds of alumina and silica, but these, if free from lime, magnesia, or metallic oxides, are exceedingly valuable clays, being from their infusible nature adapted for making firebricks for lining furnaces, for making crucibles, &c. Fire clay is found throughout the coal measures.

Machinery is fast coming into general adoption in brick manufacturing in England, and many of the machines now in general use obviate the necessity of exposing the clay to the action of the atmosphere for a lengthened period. A short reference to the most favored brick machines will not be out of place in this notice. The machines most generally used in England are Ainslie's and Hunt's. The latter consists of two cylinders, each covered with an endless web, which are so placed that they form a sort of hopper on their two upper cylindrical surfaces, the ends being enclosed by two iron plates. The tempered clay is thrown into this hopper, and at the lower part it acquires the form and dimensions of a brick. Beneath is worked an endless chain, by the movement of the cylinders; and at various marked intervals are laid the pallet-boards under the hopper, the clay is brought down by a slight pressure, and enters a frame, which has a wire stretched across it, which projects through the mass and

cuts off the requisite thickness; this is immediately removed by the forward motion of the endless chain, and this operation is renewed as often as a new pallet-board is advanced under the hopper. Such a machine produces about 1200 bricks per hour, and is worked by two men and three boys.

Machinery has been recently employed for making bricks and other articles from clay in nearly a dry state. The clay is subjected to heavy pressure in strong metal moulds, and is by this means reduced to one third its original thickness. It retains just sufficient moisture to give it cohesion, and the bricks thus formed can be handled at once and taken direct to the kiln. This method was devised by Mr. Prosser of Birmingham, and is highly useful for making ornamental bricks, floor tiles, &c. By an experiment made on a nine-inch brick of this sort, it was found that the resistance to a crushing force is immense, ninety tons having been sustained without injury. The advantage of expressing instead of evaporating the water is, that under pressure all air must be expressed from the clay.

The following were the exhibitors of bricks and tiles, &c. :—

Auckland.

77.—George Boyd, Newton, exhibits a good collection of Bricks, Draining Tiles, &c., including common machine-made bricks, ventilating or hollow bricks, segmental bricks for barrel drains, large roofing tiles, and bricks made with a mixture of the volcanic scoria ash of the neighbourhood. The common bricks are an excellent sample of machine-made bricks for ordinary building purposes, being well made and well burned. The various descriptions of hollow bricks are of the same good quality. The bricks made from the scoria-ash mixture appear to be particularly applicable for use in damp situations, being much less porous, and harder than the common clay brick. The segmental bricks for barrel drains are excellently adapted for their intended purpose, and being made hollow, are light and handy for conveyance and use. Mr. Boyd shows a form of drain-tile which combines both a surface and sunken drain, and is peculiarly adapted for court-yards, stables, &c. Besides the scoria-ash brick, the exhibitor shows bricks fixed together by what he calls scoria-ash mortar, the cohesive strength and hardness of which is extraordinary. Mr. Boyd also exhibits specimens of flower-pots and garden vases, the latter of which show some attention to the principles of design, but which might with advantage be more carefully finished.

Otago.

1040.—Wm. Hodgkison, Anderson's Bay, exhibits a quantity of Flooring Tiles, Bricks, Drain-pipes, &c., made from a fine description of clay, which is a bright red color when burned. The articles exhibited appear to be remarkably free from defect, and are well burnt. The various descriptions of flooring tiles are even and well made, and form a level and compact floor for kitchens, dairies, &c. An attempt at ornamentation has been made in one sample, by inserting designs in different clay, which when burnt assume a different color. The ornamentation of flooring tiles was brought to considerable perfection by the Romans, and in our own time the celebrated Minton has produced designs of the utmost beauty in his encaustic tiles.

1041.—J. H. Lambert, Dunedin, exhibits Bricks, Tiles, Drain-pipes, and Flower-pots of good quality and manufacture.

1042.—Nelson & Aitken, Port Chalmers, show Bricks and Flooring-tiles of good quality.

515.—Edward Swallow, Goodwood, per Waikouaiti District Committee, exhibits samples of hand-made Bricks, well burned and of good manufacture.

——.—Howell & Wilkinson, Dunedin, show good samples of Bricks.

Great Britain.

2999.—Doulton & Watts, London, exhibit Air-bricks and Paving-tiles of "Stoneware," of excellent manufacture.

SANITARY APPLIANCES.

The application of earthenware to the various purposes of sanitary arrangements is greatly increasing. For sewerage pipes, stench traps, &c., &c., it possesses many advantages over iron or other materials, being less perishable, cleaner, cheaper, and not liable to corrosion from acids or deleterious gases. With respect to earthenware contrivances for drains and sewers, many of the English manufacturers produce pipes of colossal dimensions, which, however advantageous in point of saving labor, are liable to breakage during transport, and, of course, a small fracture destroys a whole pipe. In order to meet this difficulty, segmental pipes have been constructed, the parts being grooved to fit in each other, the whole being afterwards joined together with cement. The convenience and economy of packing and exporting in parts, instead of the whole, must be great; an additional recommendation being that, in case of breakage, a segment can be easily re-placed. There are several samples of this description of

drain-pipes in the Exhibition, in the collection of Mr. Boyd, of Auckland, and that of Messrs. Doulton and Watts, of London.

The facility with which the material can be shaped into various forms, enables earthenware to be applied to a great variety of sanitary purposes, whilst its cheapness over iron recommends it to general adoption.

2999.—Doulton and Watts, London, exhibit a variety of Stone-ware, Drainage-pipes of different dimensions, including Straight Pipes, Junctions, Syphons, &c. The material is strong, and the manufacture of the articles is first-class. The pipes are fitted together with the common socket joint, the interstices being readily filled with cement, which, owing to the interior rim of the pipe being threaded like a screw, cannot fall out again. Being glazed, these pipes ensure the greatest cleanliness, and protection is afforded by the glaze against the action of acids. These exhibitors also show very useful small "Gullies" for court-yards or stables, which are so constructed as to act as stench-traps. A square box is fitted with a moveable perforated cover; from the bottom of the box a pipe proceeds, which is carried upwards until nearly on a level with the top of the box, and then connects itself with the drain; by keeping the box continually filled with water, the effluvium from the drain is effectually shut out. This simple contrivance would be an inexpensive stench-trap for street drains, and is worth the notice of the Civic Authorities in this Colony. Messrs. Doulton and Watts likewise exhibit Stone-ware Pans for Water Closets, the low price of which should greatly conduce to their general use. Water Filters of various patterns, some being chaste and ornamental in design, are shown, the value of which cannot be too highly estimated, and which no house should be without, in a country where much of the water used for drinking purposes is from the rain washing off the roofs of houses.

DOMESTIC POTTERY, CHINAWARE, &c.

As yet this Colony has made little progress in the potter's art, and the manufacture of even the commonest domestic crockery is confined to one person in Auckland. There is a great want of information concerning the clays and argillaceous earths of New Zealand, and it is to be regretted that the Exhibition has done little or nothing towards supplying this information. The Local Committes have generally confined themselves to simply securing specimens for exhibition, forgetful that *the value of the exhibits largely depends on the extent of information afforded concerning them.* This remark will apply to almost every department, and the omission is strikingly felt in the present class. A number of most interesting

specimens of pottery are sent from Auckland, but not a word of explanation is given of the clay used, whence obtained, quantity existing, &c. &c. The value of the exhibits is thus almost destroyed, for as mere specimens of the potter's art they are inferior in all respects, but as examples of the application of colonial materials, are very interesting, and would have been additionally so but for the omission pointed out.

The essential ingredients in every kind of pottery and porcelain are Silica and Alumina. The pure compound, *Silicate of Alumina*, is, it is true, an ideal type; since no clay, or artificially-prepared pottery or porcelain paste, is ever free from admixture with other ingredients, such as iron, lime, potash, &c. If, however, we remove from the paste either the silica or alumina, we render it useless for the purposes of the potter; but by freeing the paste from the accidental ingredients, the iron, lime, &c., we increase those properties which render it fit for fictile purposes. The various mixtures employed in the different branches of the manufacture have been thus classified by M. Dumas:—

Silica, alumina	Ideal type.
Silica, alumina, lime	Earthenware, crucibles, bricks, tiles, encaustic tiles and common pottery.
Silica, alumina, oxide of iron	
Silica, alumina, lime, oxide of iron	
Silica, alumina, potash	Hard Porcelain.
Silica, alumina, soda	Soft Porcelain.
Silica, alumina, magnesia	Piedmont Porcelain.
Silica, alumina, baryta	Stoneware.

The terms *soft* and *hard*, as applied to pottery, have reference not only to the composition, but also to the degree of heat to which the ware is exposed in the furnace. Thus, common brick is soft, fine brick is hard. Common earthenware vessels, as pipkins, flower-pots, &c., are soft; while crockery, such as Queen's ware and stoneware, is hard. Soft pottery is the most ancient. Soft pottery, composed of silica, alumina, and lime, is generally fusible at the heat at which porcelain is baked. It can be scratched with a knife or file. The terms *hard* and *soft* are also applied to porcelain, and they may be distinguished by applying the point of a knife, which will scratch the soft, but will make no impression on the hard. The hard kind contains a greater proportion of alumina, and less silica; it is exposed to a greater heat, and has a greater density than the soft.

After the article formed in clay has passed through the fire, it becomes converted into a porous substance termed *biscuit*, and it is rendered impermeable to water and durable under wear by means of *glazing*. For fine

wares such as porcelain, the vitreous glaze has a close analogy to the substance of the paste itself; it is not very fusible, but yet must melt at a lower temperature than the article it is destined to cover and protect. The glazes used for pottery are much more fusible. The materials for porcelain are selected and prepared with so much care that the biscuit, on leaving the kiln, is colorless; the glazes are also selected of such materials as will form a pure, transparent glass. The clays which are used for pottery being impure, and frequently containing protoxide of iron, the latter is converted, by the oxidising influence of the flame, into a peroxide, which colors the clay red. This red color of the biscuit is concealed by an opaque glaze, or by communicating a deep color to transparent glazes. The pottery glazes do not combine with the biscuit, but form a distinct layer on its surface. Coarse potteries are glazed on one firing, for which purpose a quantity of moist salt (chloride of sodium) is thrown into the kiln: the salt is volatilised and decomposed in the presence of moisture and in contact with the heated surface of the clay, which, combining with the silicate of alumina (the clay), forms a very fusible double alkaline silicate or glaze on the surface of the articles.

In the manufacture of Earthenware two principal ingredients are employed, *clay* and *flint*. The nature and proportions of these rest with the manufacturer, and upon the soundness of his judgment in these respects, more than in any peculiar art of construction, depends the excellence of his wares. The flint is first burnt in a kiln, afterwards reduced to fragments and ground. The prepared clay and flint are united by agitation, and the fluid mixture is then passed through sieves until it is reduced to the utmost uniformity and smoothness. It is afterwards boiled and evaporated to a proper consistency. The clay having thus been brought into the requisite state, is shaped into articles of earthenware by either "throwing," "pressing," or "casting." That beautiful variety of porcelain known as *Parian*, *Carrara*, or *Statuary*, is obtained chiefly by the employment of a soft felspar in the porcelain. The firing of ceramic wares is a costly process, on account of the great expenditure of time and fuel. Wedgwood introduced a great improvement by producing a ware so compounded that partial vitrifaction took place at the first firing, thus rendering a second unnecessary. Of the remaining processes of glazing and decoration, no mention need be made in this report.

Before proceeding to notice the exhibits in this Class, the Reporter feels it incumbent on him that he should recommend to the various Provincial Governments the institution of enquiries concerning the clays and argilla-

ceous earths which their respective districts contain, with a view to promoting the manufacture of at least the commoner varieties of pottery, for which we are at present dependent upon foreign manufactures, and which are rendered so costly by their bulk and breakage in transport.*

In the Auckland Department a sample of *kaolin* is exhibited, the produce of that district, and from which some of the articles shown in the Auckland Collection were manufactured. Kaolin is the name applied by the Chinese to the clay employed by them in the manufacture of the ware for which they are so celebrated, and is applied generally to pure porcelain earths. Berthier's analysis of two porcelain earths used at the Sèvres factory is as follows:—

Silica	45·06	46·8
Alumina	32.00	37·3
Lime	0.74	—
Oxide of Iron	0·90	—
Potass	—	2·5
Water	18·0	13·0
	96·7	99·6

Muspratt gives the following analyses of the most noted European porcelain earths. Kaolin occurs in granitic soils rich in felspar, but containing little mica or porphyry:—

	St. Yriex.	*Aue.*	*Passau.*	*Halle.*	*St. Tropez.*
Silica	47·09	47·64	43·65	39·62	55·80
Alumina	36·41	35·97	35·93	45·00	26·00
Potassa	1·56	—	—	—	8.20
Magnesia	2·94	—	—	3·32	0·50
Lime	—	1·57	0·88	0·07	—
Oxide of iron	—	—	1·00	—	1·80
Oxide of Manganese	—	—	—	0·19	—
Water	12·00	13·18	18·50	10·00	7·20
Loss	—	1·64	0·04	1·80	0·50
	100·00	100·00	100·00	100·00	100·00

Kaolin, to be regarded as of the first quality and suitable for the finest manufacture, should possess a body of a beautiful milk-white color, entirely free from all foreign substances however minute capable of producing stain or blemish in the subsequent stages of manufacture; also the porcelain body formed from it should be easily worked without fear of cracking, neither too fusible nor too argillaceous. Fire clay is found in the coal measures. It is *refractory*, *i.e.* resists the action of fire, in proportion to its freedom from alkaline earth and iron, which render the clay

* See Supplementary Report on Class I., App. A., Art. Clays.—Value of Imports of Earthen and China Ware in 1863, £42,077. Return for 1864 not yet published.—ED.

fusible at high temperatures. The proportions of silica and alumina in these clays vary considerably,—the silica from 50 to 70 per cent., and the miscellaneous ingredients from 1½ to upwards of 7 per cent. The celebrated Stourbridge clay consists of—silica, 63·7; alumina, 22·7; oxide of iron, 2·0; and water, 10·3 per cent.

Auckland.

78.—The only exhibitor of Colonial-made Pottery is Dr. Pollen, of Auckland, who exhibits an interesting collection of examples from the manufactory of James Wright, Whau, near Auckland. The interest of these specimens is increased by the circumstance that the Whau Pottery is the first manufactory of the kind which has been established in New Zealand. The manufactory is situated on the Auckland isthmus, and the clays from which the various samples were made are found in the neighborhood. It is to be regretted that no information is given with the exhibits with regard to their manufacture. The collection comprised articles in common stoneware and earthenware, porcelain and terra cotta. The jugs and other articles of common pottery are useful and fair specimens of this description of ware, and should, if they can be sold at a lower price than the imported goods, command a ready sale. The fruit plates and centre fruit-stand are too heavy and clumsy, and the color is a disagreeable one; still, as examples of what has been done, with only very inefficient appliances, these productions are very creditable. The porcelain butter coolers are good as regards the material, and it is pleasing to find that the ornamentation betrays considerable knowledge of the principles of taste. Mr. Wright has also attempted an imitation of those porous water-bottles which have become so widely used, and although the article he has produced is deficient in finish and form, the material is evidently suitable for the purpose for which it is intended. The water-bottle exhibited is of the description of ware known as *terra cotta*. The exhibitor shows samples of encaustic tiles which are well-adapted for the floors of passages, &c. Encaustic tiles are made from the clay after it has been partially dried. It is slapped into a block of the form of a cube or parallelopiped, and placed before the tile maker, who cuts off a square slab by passing a wire through it; upon this the facing of fine clay, colored to the desired tint, is batted out and slapped down, it is then turned over, and a facing is applied to the bottom of the tile to prevent warping. The tile, thus formed, is next covered with a piece of felt, and put into a box press; a plaster of Paris slab, containing the pattern in

relief, is then brought down upon the face of the tile, and impresses in the soft tinted clay the design which is afterwards to be filled up with clay of another color. The whole is finished off with a knife, and defects corrected: the edges are squared, and their margins rounded off with sandpaper. After being thoroughly dried, the tiles are fixed in the same way as pottery or porcelain. Those exhibited in this collection are simple in design, but useful and ornamental. The fancy butter cooler is a very creditable production: the groundwork is a dark red color, the sides being relieved by raised designs in Egyptian black. A number of small ornaments in argillaceous clay are exhibited, as well as a small piece of kaolin,* and one of Egyptian black. On the whole, this collection of specimens is exceedingly creditable as the first effort of the producer.

Great Britain.

2999. Doulton and Watts, London, exhibit a great variety of articles in Stoneware for domestic purposes, and the use of chemists, &c., viz.:—

> Ham pans from 3 to 5 gallons, salt pots, covered jars of various sizes and patterns, jugs, stoneware sink, spirit bottles, butter pots, pipkins, mugs, essence pots, spittoons, bird fountains, air-tight jars fitted with iron clamps, ginger beer and porter bottles, filters, spirit barrels up to 20 gallons, bread pans, feet and breast warmers, and perforated bricks for ventilating purposes.

The whole of these articles are of the very best manufacture in the material of which they are composed.

2997. Wm. P. and George Phillips, London, contribute an extensive assortment of Porcelain and Earthenware, remarkable for every quality that is required in articles of this description.

3000. James Green, London, R. B. Martin and Co., Dunedin, agents, exhibits China and Earthenware of the highest character. The China services are noteworthy for their chaste design and ornamentation.

1038. Matheson and Campbell, Dunedin, exhibit a very fine collection of imported China Ware.

3004. M. Calvert, Dunedin, agent for Pinder, Bourne, and Co., Staffordshire, shows a very excellent collection of imported Ware—comprising copies of the Portland Vase, Capel and Etruscan Vases, Majolica Ware, and Dinner and Toilet Services.

* See Supplementary Report on Class I., App. A, Art. Clays.—ED.

HONORARY CERTIFICATES.

77. G. BOYD, Auckland.—For Drain Pipes and Tiles of good manufacture.
78. JAMES WRIGHT, Auckland.—For Pottery of Colonial manufacture.
1040. W. HODGKISON, Dunedin.—For Bricks, Tiles, and Drain Pipes.
1041. J. H. LAMBERT, Dunedin.—For Bricks, Tiles, and Drain Pipes.
1042. NELSON AND AITKEN, Port Chalmers.—For Bricks and Flooring Tiles.
2999. DOULTON AND WATTS, London.—For superior Stoneware for sanitary and other purposes.
3000. JAMES GREEN, London.—For Glass-ware and China of good character.
1038. MATHESON AND CAMPBELL, Dunedin.—For excellent China, &c.
3004. MATTHIAS CALVERT, Dunedin.—For excellent China and Earthenware.

CLASS XXXVI.

JURORS.

T. B. HACKET, | J. S. WEBB.

THE articles included in this Class are those for which no specific classification existed. In recommending awards, the Jurors are guided in their consideration of the merit of the exhibits by the special utility of the articles, or the application in their manufacture of materials that would otherwise remain unappropriated to purposes of use or ornament.

The Jurors recommend the following exhibitors for Honorary Certificates :—

1043.—R. Boeneckie, Dunedin, for Basket-work, more especially for a Flower Stand and Arm Chair, the design and workmanship of which are excellent. The common baskets did not appear to be so good in point of manufacture as the fancy kind. It was noticed that the exhibitor had partially employed the Supplejack (*Rhipogonum scandens*), in the construction of one of the baskets, and the Jurors regretted he had not shown to what extent this abundant material can be used for basket-making. The rest of the goods exhibited are made from the common willow, imported from Tasmania. The willow grows luxuriantly in New Zealand wherever it has been planted, and its cultivation in swamps or marshy situations would be attended with profit.

1044.—J. F. Davis, Dunedin, for two Wigs, the hair of which is singularly interwoven with a transparent foundation, so that the artificial nature of the covering is completely concealed.

1047.—M'Nae and Morton, Dunedin, for Paste Blacking of good quality, manufactured by the exhibitors. The polishing quality of the blacking was tested by a very efficient Rotary Brushing Machine, exhibited in the Annexe, and the result was most satisfactory.

3003.—George Kent, London, for his collection of Domestic Labor-saving Machines; recommended for utility and general excellence. The exhibits included Patent Rotary Knife-cleaning Machines, Whisk and Mixing Machines of Griffiths' patent, which consists of an iron framework attached by clamps to an iron or earthenware vessel containing two wire agitators revolving in opposite directions and intersecting each other; the motion being given by a small handle, on the shaft of which a spur wheel is fixed, which turns two other cogged wheels on its upper and lower circumference. The same principle is applied to large and small vessels, the smaller ones being made of porcelain. A thorough incorporation of the substances desired to be mixed, is accomplished in a few minutes by this machine. The principle can also be adapted to many manufacturing purposes, such as brewing, dyeing, &c., where perfect admixture of ingredients is required.

Apple Paring Machine, by which apples can be pared and cored in a few seconds. The apple is fixed on a revolving tripod, which, by a screw motion, brings to bear on the apple two knives so adjusted as to follow all the irregularities of surface, and pare and core the fruit with very little waste. This little machine, by taking off the coring knife, can be used for paring potatoes, turnips, &c. of moderate size.

Cistern Filter, an earthenware jar containing chocolate, &c., placed in a tank or cistern, a flexible syphon pipe being attached to the upper part draws the water up through the filtering material.

A Portable Moulded Carbon Pocket Filter is also exhibited, most valuable to travellers or explorers, for by its means a draught of clear water can be obtained from the muddiest pool.

Patent Clothes-wringing Machine.—A very convenient and effective machine. It consists of two vulcanised india-rubber rollers, about two inches diameter, fixed in an iron frame, which can be readily attached to a washing-tub or table. The pressure is supplied by a spring and can be increased at pleasure. For the smaller articles of wear this little machine cannot be surpassed, as it combines great pressure with absolute impossibility of damage.

—.—R. B. Martin & Co., Dunedin, exhibit T. Bradford's (Manchester) Patent Combined Washing and Mangling Machine. This is another of those excellent contrivances for saving domestic labor, invaluable in a Colony. Like Kent's Knife Cleaner, and his other labor-savers, it only requires to be known to be appreciated. All such machines, of course, require to

be used with some degree of attention to their construction. Those who have not succeeded with them can only have failed from inattention to the directions forwarded with them. Some people almost seem to imagine they may use a machine in any way they choose, although perfectly ignorant of its construction; but unless they will take the trouble to comprehend and adhere to the instructions of the makers, they had better not attempt to use the machines; if they attend strictly to the directions, they will find that Bradford's Washing and Mangling Machines, Kent's Knife Cleaner, Egg Beaters, Apple Parers, &c., &c.; Stevens' Bread-maker, and Wheeler and Wilson's or Singer's Sewing Machines, are really what they profess to be—*domestic labor-saving machines.*

The other Exhibitors in this class are as follows:—

79. John B. Wootteen, Matakana, Auckland:—Corn Brooms; presumed material, millet; but no information given by exhibitor.

1045. J. W. Jago, Dunedin, Jug and Brooch; jug said to be 200 years old.

1048. Ed. Pritchard, Rattray-street, Dunedin, exhibits a case containing Illustrations of the Anatomy of the Horse's Foot, and the points to be observed in horse shoeing. The preparation of these specimens is highly creditable to the exhibitor.

1049. A. C. Rees, Dunedin, shows a number of Meerschaum Pipes, the mountings of which are of Otago gold, wrought by local artizans. The mountings are chaste and appropriate in design, and well finished. Mr. Rees exhibits a Maori pipe, carved from some kind of hard wood and mounted with lead. It was found at the Gate Pah after the terrible fight there.

1050. Carl Steinhoff, Dunedin:—A case of Meerschaum Pipes imported by exhibitor direct from Vienna. Many of the pipes have figure-heads of highly artistic character.

1052. J. A. Steadman and Co., Dunedin, exhibit an exceedingly useful travelling appliance—a Portable Set of Officers' Cooking, and other Utensils, consisting of spirit lamp, kettle, boiler, frying-pan, cups and saucers, egg cups; cases for tea, coffee, and cigars; and box of knives, forks, and spoons; all of which pack into a small canteen, which can be strapped on the shoulders and carried with ease. A most useful arrangement for field service, or for pic-nics, &c.

1053.—Mrs. Catherine Sutherland, Dunedin, Tea Caddy and Snuff Box, made from timber of Glasgow Cathedral, founded 1181.

1109.—James Quin, Dunedin, a Music Stand very ingeniously constructed from one piece of wood, and which can be folded flat when not in use.

1110.—William Pagan, Specimens of Wood Engraving applied to stamps for marking linen, books, &c.

1111.—John Grey, exhibits curious examples of Paper Splitting. Sheets split in two without a single flaw are shown, of the *Times, Daily Telegraph,* and *Illustrated London News.*

HONORARY CERTIFICATES.

1043. R. BORNECKIE, Dunedin.—Basket Work of Excellent Workmanship.

1044. J. FLEETWOOD DAVIS, Dunedin.—Wigs.

1047. MCNAB & MORTON, Dunedin.—Blacking.

3003. GEORGE KENT, London.—Very useful Domestic Labor-Saving Machines.

1048. ED. PRITCHARD, Dunedin.—Illustrations of Horse-shoeing, &c.

CLASS XXXVI. B.

MAORI AND OTHER ABORIGINAL MANUFACTURES AND IMPLEMENTS.

CONTAINING, as New Zealand does, an aboriginal population numbering between 50,000 and 60,000 souls, this Exhibition would have been incomplete without including within its objects, the exhibition of articles of Native manufacture, and specimens illustrative of the arts and customs of the Maori race. The Maoris have most deservedly been considered one of the finest and most intelligent of aboriginal races. Their intellectual and physical powers have from the time of Cook downwards enlisted the admiration of travellers, and the respect of the Colonists. Compared with the Native inhabitants of Australia, and of many of the uncivilized islands in the South Pacific, the Maoris stand out as their superiors in every respect. Their extreme aptitude has enabled them to adopt easily many of the habits and customs of European civilisation, and to throw off a great deal of the barbarism of their forefathers. When it is borne in mind that a great proportion of the Maori population now wear European clothing, eat and drink European food and liquor, use European tools and utensils, plough their lands with iron ploughs, and thresh and grind their corn by machinery, own and navigate vessels built and rigged in the European fashion, and fight with European rifles and gunpowder—when these things are remembered it becomes increasingly interesting to study the rude tools, weapons, clothing, and other articles which they employed or manufactured in byegone days. Excepting in a few special articles, the traditionary manufactures and weapons have become almost obsolete amongst the Maoris, and it is acknowledged by themselves that some of their formerly most cherished arts are being rapidly forgotten. If at any future time the Native inhabitants should become amalgamated with the Europeans—if a century hence there remains a civilised and cultivated remnant of the Maori race—the relics of the past and the memo-

rials of the rude but ingenious skill of their ancestors will become to them invaluable records. The arts and manufactures of a people are the most valuable records of its history. What important ethnological facts have been ascertained and established by means of bits of broken pottery or rusted metal! The history of the Maori race is still unwritten, but in their habits, language, weapons, tools, and manufactures, we trace their affinity to other races, and are enabled at any rate to build up reasonable conclusions as to their origin. For many reasons it is desirable that collections of aboriginal implements and productions should be preserved. They are not only interesting but instructive, and it was with this view that objects of this character were afforded a place in the Exhibition, and they constituted by no means its least attractive feature.

In reporting on the nnmerous objects in this Class, it is perhaps the most desirable plan to divide them into two classes, viz: Articles of Use, the manufacture of which is partially or wholly preserved at the present day; and Articles of Ornament, Weapons, and miscellaneous objects.

ARTICLES OF USE.

All savage nations in some way or other make a convenient use of the natural productions of the country in which they live. But there are great differences in this respect: there are degrees of barbarism as there are degrees of civilization. Some races are endowed with greater ingenuity than others, and keener perceptions of what is applicable for their various purposes. Some savages know no other adornment or covering than perishable leaves, whilst others have carried the weaver's art to perfection, and placed all those members of the vegetable kingdom under tribute that can yield them a fibre. "The New Zealander," says the Rev. Richard Taylor,* "is acquainted with every department of knowledge common to his race: he can build his house; he can make his canoe, his nets, his hooks, his lines; he can manufacture snares to suit every bird; he can fabricate his garments, and every tool and implement he requires, whether for agriculture or war; he can make ornaments of ivory, or of the hardest stone; and these too with the most simple and apparently unsuitable instruments, sawing his ivory without loss, with a mussel shell, and his hard green jade-stone one piece with another, with only the addition of a little sand and water; and all these works, it must be remembered, he could accomplish without the aid of iron, which was unknown before Cook's time. The Native is not deficient in those arts which are

* Taylor's New Zealand. London, 1855.

essential to his comfort. His house is constructed with great skill and elegance, his garments with much beauty, and ornamented with a border of elaborately wrought embroidery."

The articles of clothing used formerly and still partially retained by the Maoris, were in most cases manufactured from the Native flax or *Phormium tenax.* The Maoris are very successful in the preparation of the fibre of this plant, as the beautiful silky texture of their mats shows. They cultivated the plant, carefully selecting the various kinds of leaves for the different purposes to which the fibre was to be applied. The coarser fibre was used for rough common mantles or mats, and the fine silky threads for their fishing lines and best garments. There are several kinds of flax mats. That kind called *kaitaka* is the softest and most valued; they vary in size, some being as large as twelve feet long and seven wide. They are made of close parallel lines of soft twisted flax, with transverse threads at intervals of about an inch. The "weft," if we may so call it, is knotted round the warp, six or seven threads of which are taken up in each knot. They generally have borders of about a foot in width, of closely-woven material, beautifully embroidered in ingenious patterns with black or red threads. The weaving of one of these mats occupied one person eight months. The inhabitants of the East Cape were noted as the most expert manufacturers of this mat. There were several very fine specimens of the *kaitaka* mat in the Exhibition, exhibited by his Excellency Sir George Grey (80), the late unfortunate Rev. R. C. S. Volkner (81), Wm. Colenso (168), and by the Chief Tareha (167).

Another description of mat is called *korowai.* It is generally about six feet square, smooth inside, but having outside a number of black strings seven inches long dangling from it. This mat, like the *kaitaka*, has a very open texture. Specimens of this kind of mat were exhibited by the Chief Karaitiana (161); W. Colenso (168); and Waitaoro (240).

The mat called *taupo* is made of flax leaves, seven inches long and three-quarters of an inch broad, attached to a smooth coarse mat; every third leaf is dyed yellow, and the rest black. This mat is perfectly impervious to rain. A specimen was exhibited in the Hawke's Bay collection.

The *pureki* mat is another waterproof covering, made of roughly prepared flax fibres, eight inches long, attached by one end to a coarse mat. It differs from the *taupo* mat in the flax being more scraped and not dyed.

The *toi* mat is made of flax leaves dyed black, seven inches long and three-quarters of an inch broad, twisted and torn so as to leave some green fibres. The *kupura* is a very rare mat, and is, like the *kaitaka*, without the border, and is dyed black.

The *kotikoti* is a mat which is so fabricated as to allow close rows of pipe-shaped tassels to hang down. These pipes are made by exposing the green flax leaf to the fire, which causes it to curl round in the form described. This mat rattles when the wearer walks.

The *pukupukū* is a mat of closely woven flax, and used as a sort of armour against spears.

Specimens of all the above were forwarded for exhibition.

Mats were also made of dogskin *(shupuni)*, and of the feathers of various birds, especially the kiwi.

Although the Maoris have only a tradition to that effect, there is reason for believing that they were formerly acquainted with other methods of manufacturing cloth for garments. The inhabitants of many of the South Sea Islands, it is well known, make a sort of cloth by macerating and beating out the bark of the paper mulberry. The Rev. Mr. Taylor, in his work already alluded to, says: "Tradition also states that they (the Maoris) had finer garments in former days, and of different kinds; that, like their reputed ancestors, they made cloth from the bark of trees; the name is preserved, but the manufacture has ceased." The name by which this bark-cloth is known is "*aute*." An exhibit (760) in the Otago Museum Collection appears to throw a good deal of light on the subject. It is a piece of cloth found in a cave in the Dunstan ranges, Ōtago, and probably a portion of burial clothing. It is very much like the "*tapa*" of the Fijians, and is evidently made by macerating and felting together some fibrous bark or leaf. From apparent divisions in the texture about the width of a flax leaf, it was considered by some to be composed of that material, but it is most likely made of the paper mulberry or some other fibrous bark—perhaps the Hohere (*Hoheria populnea*) or Ribbon tree. It is in a very good state of preservation, and is a most interesting relic of Native manufacture.

Very good collections of Flax Mats were exhibited by the Rev. Mr. Reimenschneider (1060), and by the Waikouaiti District Committee (1061).

The fibre of the native flax also supplied the Maoris with sails for their canoes, fishing lines, and nets. In the two latter much ingenuity was displayed. A specimen of a peculiar and rare kind of fishing line

was contained in the collection exhibited by W. Colenso, Napier. From the flax-leaves the Natives manufacture excellent baskets or kits, in which they convey their provisions and produce. Some are roughly made, and others display great taste in the pattern. To the present day most of the agricultural and horticultural produce of the Maoris, excepting corn, is conveyed to market in these kits, which find a ready sale amongst the Europeans in settlements near Native villages. Specimens of various kinds of baskets or kits were exhibited by Sir George Grey (80); W. Young (83); W. Colenso (168); and the Rev. Mr. Reimenschneider (1060).

Very interesting specimens of the Native flax, in the different stages of preparation for the manufacture of mats, &c., were exhibited by W. L. Buller, Manawatu (246), and by William Davies, Otaki (248). A reference to the Native method of preparing the fibre will be found in the Report on Class IV. Sub-Class C. The floats used by the Natives for buoying their fishing nets were made of a peculiar light and pithy wood called "Whau" (*Entelea arborescens*), the specific gravity of which is less than that of cork.* Some specimens of this wood were exhibited in the Auckland department.

The tools employed by the Maoris for shaping the hull of their canoes, felling trees, &c., were made of various kinds of hard stone, shaped into the form of adzes and axes. Quantities of these old tools and weapons are found on the sites of old Native villages, and in caves and other burial places. The stems of their canoes were ornamented with figure-heads and carved prows, the execution of which displayed wonderful skill and knowledge of art. These carvings were generally made of very hard wood, stained black. The pattern was always an open-worked design, similar to the Indian and Chinese carvings in ivory—circles and intersecting curvilinear lines, tastefully and regularly arranged. The figure-head was generally a rude copy of a human head, the proportions and treatment of which exhibited a surprising degree of artistic skill. The Exhibition contained several beautiful models of canoes, made by the Natives as memorials of some canoe of their ancestors. The paddles are made of various kinds of wood, those made of manuka being much esteemed. Their handles are occasionally carved, and their form is constructed so as to cause them to enter and leave the water easily and smoothly. Models of canoes and paddles were exhibited by Sir George Grey, (80); the

* See Appendix C. Report on Woods by J. M. Balfour, C.E.—ED.

Auckland Local Committee (84); and by Donald M'Lean, Superintendent of Hawke's Bay (166). This latter model had a special interest attached to it. It was made by a Native Chief of Hawke's Bay, and is supposed to be a model of an ancestral canoe called "Takitimu," in which the ancestors of the tribe came from Hawaiki to New Zealand. The canoe is often referred to in their speeches as symbolic of peace, or to announce that the descendants of their ancestors, who came to New Zealand in the canoe "Takitimu," would use every effort to preserve peace in Hawke's Bay.

The Maoris, unlike the inhabitants of the Fiji Islands, appear to have been ignorant of the potter's art. Their drinking-vessels and bowls were constructed of gourds, wood, or bark. At great feasts, the chief delicacies were placed in large *hua* or calabashes, or in ornamental dishes made of the bark of the totara. Their principal crockery—if one may use the term—was supplied by the *hue* or gourd. In it the New-Zealander carried water, stores, potted fish, birds, or flesh; he also used it as a dish and even as a lamp. These dishes were often beautifully ornamented with tattooing. Specimens of these vessels were shown in the Exhibition. Spoons and pronged forks were made of wood; Mr. Colenso's collection included specimens of these.

Fish-hooks, in the construction of which the Maoris displayed great ingenuity, were made of human bone, wood, and sharks' teeth. Several examples of the various kinds of fish-hooks were exhibited by Sir George Grey, Mr. Colenso, and others. An ingenious saw, made of a row of sharks' teeth firmly lashed to a piece of wood, was shown in Mr. Colenso's collection. Beautifully-carved boxes, the design and execution of which exhibit great skill, were exhibited by Sir George Grey and the Auckland Local Committee. They are about as large as a good-sized work-box, with projecting carved handles, the lid and sides carved in a small and graceful pattern.

ARTICLES OF ORNAMENT, WEAPONS, AND MISCELLANEOUS OBJECTS.

Like some of their more civilized brethren, the Maoris are passionately fond of adorning their persons with trinkets and other ornaments. At the present day many of the decorations formerly used have been discontinued. Ear ornaments are in general use, they are worn by both sexes, and are of great variety. Those of greenstone "poenamu" are the most highly prized; and sharks' teeth of large size are also held in high estimation. Sometimes ear ornaments are made of the feathers of the Huia

or Tui birds. The neck ornament is generally of greenstone, carved into the resemblance of the human figure. These are called *heitiki*; the image is not unlike a Hindoo idol, having an enormous face, and badly shaped legs of disproportionate size. Some heitikis were about the size of shillings, others were as large as plates. This ornament was a sort of heir-loom, being handed down from father to son. When a long absent relative arrived at a village, the heitiki was taken from his neck and wept over for the sake of those who formerly wore it. Heitikis were deposited with the bones of the dead until they were removed to their final resting place. Every tradition respecting this image is forgotton, but it is evidently connected with their mythology. Haumia tiki tiki is the god of cultivated food amongst the New Zealanders, and tiki in various South Sea Islands is the name of an image. One of these ornaments was exhibited in the collection of Sir George Grey.

The Ear Pendants of greenstone vary in form; some are narrow pieces, from three to five inches in length, and others are round, thin and flat. They are suspended by a piece of black ribbon. The "Poenamu" (*Nephrite*, *Greenstone*, or *Jade*), of which the Maoris make so many articles of personal adornment, and which in former times was extensively employed by them for tools and weapons, is found chiefly on the West Coast of the Middle Island. Captain Cook calls the whole Island *Tovai poenamu*, and *Te Wahi poenamu*; or the Water of the Greenstone, is a name written in old charts against a lake in the Middle Island. The words are corruptions of *Te Wahe poenamu*, or the place of the greenstone, by which the Western portion of the Middle Island was known amongst the Maoris. In some districts of the West Coast the greenstone is found in large masses, and it is somewhat difficult to account for the high value placed upon it by the Natives, excepting from the circumstance that the western portion of the Middle Island was but little known to them. Its geographical distance from the centres of population, added to the extremely difficult access to it, rendered the acquisition of the *poenamu* no easy matter. Certain it is, however, that this greenstone has for a long time been the most highly prized material employed by the Maoris in the adornment of their persons. The old Maori traditions placed the district from whence they derived their supplies about midway down the West Coast of the Middle Island, and some interesting particulars of a visit to it by Messrs. Brunner and Heaphy are given in an account by the last-named gentleman, contributed by him to the *New Zealand Monthly Magazine*, of October and November, 1862. Passing by the description

given of the wild and rugged country through which the explorers had to pass, we come to the account of the native settlement at Taramakau :—

"At Taramakau, eighteen miles from Kararoa, we came upon the chief settlement of the Ngaterarua, or Greenstone people, some forty souls in all; and every man, woman, and child indolently engaged in sawing, grinding, or polishing greenstone. Taramakau village was unlike any other Native settlement in New Zealand; every house had a chimney, and, there being no pigs or other neighbours, fences were unnecessary, and the taros and potatoes grew about and between the houses.

"That we had at length reached the veritable Greenstone Country was very evident. Outside the principal house, the Chief of the place had laid by a slab of poenamu, out of which he was sawing a *mere* when he came to welcome us. In another place, an old man—too old to move out to meet us—chanted some sort of song of welcome, and kept up a sawing accompaniment. Little children ran about with toy pieces of *kawa kawa*, and brought us smooth pebbles of it as presents; *Heitiki*—the uncouth figures with red sealing-wax eyes that are worn hung round the neck—were receiving the last polish; and fragments of greenstone—odd knobs, and rejected cross-grained pieces—were lying about the houses, and down the beach, in a way that would have made a Ngapuhe crazy could he have beheld it.

"Along the whole extent of the West Coast—from Cape Farewell to Dusky Bay, this is the only Maori community. Some fugitive Natives are occasionally to be found about the Sounds south of Milford Haven, and the Natives from Arahura make excursions to obtain a peculiar kind of greenstone from near Wakatipu, and may be occasionally seen at Jackson's Bay or Cascades, but there is no other regular village. The people are chiefly a remnant of the Nga-i-tau tribe that formerly occupied the country round Otago and Bank's Peninsula, and extended over the Island to the West Coast, for the purpose of working the greenstone. Rauparaha and the Taranaki tribes, with their guns, scattered them in a series of bloody engagements on the East Coast, and afterwards the Ngatitoa tribe, under other leaders, came down from Massacre Bay, by the coast track that we followed, and defeated them on the West side. But the sight of the poenamu had a pacifying influence, and before long intermarriages took place; some of the Ngatitoa remaining at Taramakau, and others returning to Cook's Straits with a tribute of greenstone meris. * * * The poenamu is a vein stone, like quartz or felspar, and traverses rock of primitive formation. The river Arahura, nine miles from Taramakau,

appears to cut through some veins of this stone, and to bring down fragments of it in the floods. On the subsidence of the water, the Natives wade about searching for it in the river bed, and the heightened color of the stone in the water soon reveals it to them.

"Of poenamu there are the following kinds, viz.:—

"1st, the inanga; 2nd, the kauairangi; 3rd, the kawa-kawa; and 4th, maka tangi wai.

"The inanga is the most valued by the Maoris; it is rather opaque in appearance, and is traversed with creamy-colored veins. The best *meres* are usually made of this stone.

"The kauairangi is of bright green color, with darker shades, or mottled, and is the most translucent; it is a brittle material, and not easily worked —ear pendants are frequently made of it.

"The kawa-kawa is of a dark olive green, and has rather a dull and opaque appearance; hei-tiki (little images), and ear pendants are composed of it.

"The maki tangi wai is the least esteemed by the Maoris, but by far the most beautiful of all. It is of clear pale green, and is very translucent. The Natives will drill a hole through a pebble of it and hang it to a child's ear, but do not care to fashion it into any shape. It is the only kind of poenamu that would be esteemed for purposes of ornament by Europeans.

"In order to make a *Mere*, a stone is sought of a flat, shingly shape – say of the size and roughly of the shape of a large octavo book. Among the primitive rocks of the Middle Island stones are not wanting of sufficient hardness to cut even the poenamu, and the Arahura natives lay in a large stock of thin pieces of a sharp quartzose slate, with the edge of which, worked saw fashion, and with plenty of water, they contrive to cut a furrow in the stone, first on one side and then on the other, until the piece may be broken at the thin place. The fragments that come off are again sawn by children and women into ear pendants. With pretty constant work—that is, when not talking, eating, doing nothing, and sleeping—a man will get a slab into a rough triangular shape, and about an inch and a half thick in a month, and with the aid of some blocks of sharp sandy gritted limestone will work down the faces and edges of it into proper shape in six weeks more. The most difficult part of the work is to drill the hole for the thong in the handle. For this, pieces of sharp flint are obtained from the Pahutani cliff, forty miles to the north,* and are set in the end of a split stick, being lashed in very neatly. The stick

is about fifteen or eighteen inches long, and is to become the spindle of a large teetotum drill. For the circular plate of this instrument the hardened intervertebral cartilage of a whale is taken; a hole is made through, and the stick firmly and accurately fixed in it. Two strings are then attached to the upper end of the stick, and by pulling them a rapid rotatory motion is given to the drill. When an indentation is once made in the poemanu the work is easy; as each flint becomes blunted it is replaced by another in the stick, until the work is done. Two *meres* were in process of formation while we stayed at Taramakau, and one had just been finished. A native will get up at night to have a polish at a favorite *mere*, or take one down to the beach and work away by the surf. A piece of poenamu and some slate will be carried when travelling, and at every halt a rub will be taken at it."

The above interesting description of what must at one time have been an important branch of Maori industry, shows how laborious was the process of greenstone manufacture, and supplies at least one reason for the high estimation in which articles made of the poenamu were held by the Natives generally.

Weapons.—For personal conflicts the New Zealanders had several deadly weapons, and, like all races ignorant of iron, they used hard minerals for making keen-edged ones. Of these, the greenstone "Mere" was the most esteemed. It weighs about six pounds, is about a foot long, and in shape resembles a powder-flask flattened. Its edges are sharp as a knife, and in the handles is a hole for a loop of flax or leather, which is twisted round the wrist. Sometimes meres are made of wood or whalebone, and in such instances are fashioned into various shapes and ornamented on their handles with carvings. The meres are deadly weapons at close quarters, and a single blow with one on the head will cause instant death.

There were several fine greenstone meres in the Exhibition, in Sir George Grey's collection (80), and some noted ones were exhibited by various Native Chiefs. To all of these some legend is attached The mere exhibited by Hohepa Tamaihengia (237), is called "Taturamoa," and has figured in many a deadly fight. Another fine mere was exhibited by the Chief Waitaoro (242). It has been used in several engagements, and has a flaw in it done in breaking a Maori's skull. Oriwia te Hurumutu, daughter of the great Chief Pehi, exhibited two meres (243 and 244), one of whalebone and the other of greenstone. Both have legends attached to their history; the former belonged originally to the father of the Rebel Chief, William Thompson.

The "Patu" is a wooden weapon, not unlike a violin in shape, and a little larger than the mere. One is exhibited by Sir George Grey.

The Maoris had five sorts of wooden clubs, which were occasionally highly carved, and ornamented with feathers and dyed flax.

The "Toki," or adze, was a favorite weapon. Its handle was made of wood, two feet long, and the adze of greenstone, jade, jasper, or granite. Many specimens were exhibited by various contributors. Peter Thomson (1061), exhibited a number of stone axes, ear ornaments, &c., found on the site of an old Maori settlement near Blueskin Bay. Joseph Reid (1059), sent some fine specimens. Spears, "Taiaha," were another kind of weapon; they were barbed with sharks' teeth, and ornamented with the feathers of the "kaka" or parrot. They are now only used as symbols of authority, and for flourishing about when haranguing. Taiahas were exhibited by Sir George Grey (80), and Hohepa Tamaihengia (238). Other spears, sharp at both ends, and from four to fourteen feet long, were formerly used, specimens of which were in the Exhibition.

Miscellaneous Objects.—The Maoris were not without musical instruments. They had two—the flute and the trumpet. The flute, varying in length from two feet to three inches, was open at both ends, and had either two or five holes. In ancient times they were often constructed from the hollow bones of men, but latterly only wood has been employed. They played them by blowing into one of the holes, or into one of the ends; the best instruments only produced five simple notes. A specimen of the bone flute was exhibited by Sir George Grey (80). The Maoris had also a kind of trumpet made of wood, seven feet long, and used for raising an alarm in time of war. A specimen made of supplejack was exhibited by Karaitiana (162). Combs for the hair were made of bone, a specimen of which was in Sir George Grey's collection. A curious genealogical staff is exhibited by Waru Werahiko Moeangiangi (147). It was the custom of the priests of several tribes to keep nominal lists of their hereditary chiefs, and for this purpose sticks were fashioned, upon which a notch was made as each warrior died. These sticks were preserved by the priests and called "papatupuna," and it was the duty of these holy men to keep this ancestral knowledge in the people's memories, in order to accomplish which they occasionally repeated before the assembled multitude the names of the tribe's dead chiefs. Says Dr. Thomson in his *Story of New Zealand:* "From a careful examination of several of these genealogical trees, I conclude there have been about twenty generations of chiefs since the arrival of the first Natives from Hawaiki." The specimen

in the Exhibition represents the pedigree of the tribe of the owner since their first arrival in New Zealand. It was with great reluctance that the owner parted with it for the purpose of exhibition.

The Maoris are great smokers, and are able to manufacture their own pipes in imitation of those of the Europeans. J. Grindell, Napier (160), exhibited three neat wooden pipes made by Natives at the Wairoa. They are but slightly inferior in appearance to the wooden pipes sold by tobacconists. A pipe, mounted with a leaden rim, was exhibited by A. C. Rees, Dunedin (1049), this pipe was picked up in the Gate pah after the engagement at that place.

A number of relics to which a painful interest is attached, are exhibited by George Donne, Marlborough (329). They consist of Maori tomahawks of stone, and rusted bayonets dug up recently at Massacre Hill, Wairau, Marlborough, and are most probably mementos of the terrible massacre of Captain Wakefield and his party in 1842. This affray arose out of a disputed land sale of the Wairau plains. The surveyors were at work on the plain, when the celebrated chief Rauparaha crossed Cook's Straits with an armed band, burnt down their huts and drove them off. They carried the news to Nelson, and the Magistrate issued a warrant for the apprehension of Rauparaha on a charge of arson. The Magistrate, with Captain Arthur Wakefield, three other gentlemen, and some special constables, went to execute the warrant. A collision ensued, and six and twenty men were slain. The Queen's Magistrate and Captain Wakefield were murdered in cold blood after the affair was over.

It is to be hoped these relics will be obtained for the Colonial Museum.

This concludes our notice of the Maori exhibits.

FIJI ISLANDS.—Several exhibitors have forwarded a variety of interesting articles from the Fiji Islands, concerning which some remarks are necessary. The inhabitants of the Fiji Islands possess many habits and customs almost identical with those of the Maoris; but the different conditions of climate and mode of life, coupled with the difference in the natural productions of the country, have led to a considerable diversity in their arts and manufactures. The Fijians, judging from their tools, weapons, and clothing, are but little behind the New Zealanders in skill, whilst in some respects they are in advance of them—in the art of pottery

for instance. The various objects from these islands which found a place in the Exhibition, are not the less interesting because they are illustrations of the existing habits and customs of the Fijians.

Beginning with the article of clothing, we find many beautiful specimens of cloth called "tapa,"* made by macerating and beating out the bark of the paper mulberry. The following interesting description of the materials used for clothing by the Fijians is taken from the most recent work on the Fiji Islands, *A Mission to Viti*, by Dr. Seemann :—

"Materials for the scanty clothing worn by the Fijians are readily supplied by a variety of plants, foremost amongst which stands the Malo or Paper Mulberry (*Broussonetia papyrifera*, Vent.), a middle-sized tree, with rough trilobed leaves, cultivated all over Fiji. On the coast, the native cloth (Tapa) and plaitings are gradually displaced by cheap cotton prints, a fathom of which is considered enough for the entire dress of a man. In the inland heathen districts the boys are allowed to run naked until they have attained the age of puberty, and publicly assumed what may be termed the *toga virilis*—a narrow strip of native cloth (Malo) passing between their legs, and fastened either to a waistband of string, or to a girdle formed by one end of the cloth itself. The length of the Tapa hanging down in front denotes the rank of the wearer. A fine kind of Tapa (Sala) is worn in the shape of a turban by those who let their hair grow long. The manufacture of native cloth is entirely left to women of places not inhabited by great chiefs, probably because the noise caused by the beating out of the cloth is disliked by courtly ears. The rhythm of tapa-beating imparts, therefore, as thoroughly a country air to a place in Fiji as that of threshing corn does to our European villages. The Masi tree is propagated by cuttings, and grown about two or three feet apart, in plantations resembling nurseries. For the purposes of making cloth, it is not allowed to become higher than about twelve feet, and about one inch in diameter. The bark, taken off in as long strips as possible, is steeped in water, scraped with a conch shell, and then macerated. In this state it is placed on a log of wood, and beaten with a mallet (Ike), three sides of which have longitudinal grooves, and the fourth a plain surface. Two strips of Tapa are always beaten into one with the view of strengthening the fibres—an operation increasing the width of the cloth at the expense of its length. It is easy to join pieces together, the sap of the fibres being slightly glutinous ; and in order to

* "Kapa," in some dialects.—Seemann.—ED.

make the junction as perfect and durable as possible, a paste is prepared of arrowroot, or a glue of the viscid berries of the Tou (*Cordia Sprengelii* De Cand.) I have seen pieces of native cloth, intended for mosquito curtains and screens, which were nearly one hundred feet long and thirty broad. Most of the cloth worn is pure white, being bleached in the sun as we bleach linen, but printed Tapa is also, though not so frequently, seen, whilst that used for curtains is always colored. Their mode of printing is by means of raised forms of little strips of bamboo, on which the color is placed, and the tops pressed; indeed, the fundamental principle is the same as that of our printing books, the little strips of bamboo standing in the place of our types. The chief dye employed is the juice of the Lauci (*Aleurites triloba*, Forst.), and the pattern, though rudely executed, often displays much taste.

"The most simple form of an article of dress, and one much worn in Fiji, is called "*Liku*," consisting of a number of fringes simply attached to a waistband. Liku is made of many different plants, the most esteemed being the entire body of a species of *Rhizomorpha*. The plant is called vernacularly "Wa loa," literally, black creeper. It grows in swamps on decaying wood fallen to the ground; the threads of which it consists are several feet long, leafless, and not much branched. The threads, having been beaten between stones in order to free them from impurities adhering, are buried for two or three days in muddy places, and are then ready for plaiting them to the waistband.

"The Liku worn by the women are made principally of the fibres of the different species of Vau; the Vau dina (*Paritium tiliaceum*, Juss.), the Vau dra (*Paritium tricuspis*, Guill.), and the Vau damudamu (*Paritium purpurascens*, Seem.) The bark of these trees is stripped off, steeped in water to render it soft and pliable, and allow the fibres to separate. The fibres are either permitted to retain their original whiteness, or they are dyed yellow, red, or black. The yellow color is imparted with turmeric, the black with mud and the leaves of the Tavola (*Terminalia catappa*, Linn.), and the red with the bark of the Kura (*Morinda citrifolia*, Linn.), and that of the tiri (*Guttiferæ ?*)

"Mats, with which the floors of houses and sleeping-places are thickly covered, are made of two kinds of screw pines: the coarsest, of the leaves of the Balawa (*Pandanus odoratissimus*, Linn.); the finest, of those of the Voivoi (*Pandanus caricosus*, Rumph.) The Balawa, or Badra as it is sometimes termed, is a tree twenty-five feet high, with leathery sword-shaped leaves. The Voivoi or Kiekie is a stemless species, with leaves 10 to 12

feet long. Fans, baskets, and the finest mats are made of its bleached leaves. Occasionally neat patterns are worked in, by introducing portions of the material dyed black, whilst the borders of highly-finished mats are tastefully ornamented with the bright red feathers of the Kula—a paroquet. The bleached leaves are also employed for decorating the body, being tied by the men over the head-dress and on various parts of the person. A certain kind of mats, worn as articles of clothing, are called "Kuta," from a species of sedge (*Elæocharis articulata*), supplying materials for them, growing in swamps to the height of six feet or more. Baskets are also made of the leaves of the cocoa-nut palm, and the stem of the *Flagellaria Indica* (Linn.) split up in narrow strips.

"Fibre used for cordage is derived from three species of Vau, the cocoa-nut palm, the Yaka (*Pachyrhyzus angulatus*, Rich.), the kalakalauaisoni (*Hibiscus diversifolius*, Jacq.), and the Sinu Mataiavi (*Wikstræmia Indica*, Meyer). Plaiting cocoa-nut fibre into 'sinnet,' afterwards to be made into rope, or simply used for binding material, is a favorite occupation of the men. Mr. Pritchard, Her Majesty's Consul at the Fijis, mentions having seen a ball of sinnet six feet high and four feet in diameter. Some heathen temples used to be entirely composed of such plaiting. The fibre of the Yaka is principally sought for fishing-nets; the Sinu Mataiavi, a sea-side shrub, serves the same purpose, its bark containing a readily available fibre."

Specimens of "Tapa" are exhibited by J. Le Quesne, Hawke's Bay (164); W. Colenso, Hawke's Bay (168); T. M. Hocken, Dunedin (1055); and H. Nelson, Dunedin (1058). The above-named exhibitors, as also Mrs. Muir, Dunedin (1057), and William Jeffreys, Dunedin (1056), send a numerous variety of Fiji Clubs and other curiosities. Some of the cocoa-nut mats are worked into various elegant patterns, and exhibit great skill in the manufacture. The clubs are very heavy weapons about five feet long; the spears are long, and pointed with the sting of the sting-ray fish. Girdles of Hibiscus fibres, six inches wide, and dyed black, brown, and yellow, are worn by the women. For tying purposes, the Fijians use the fibre of the cocoa-nut beautifully plaited into sinnet. Pillows are made of a thick stick with four legs, and are just put under the neck, so that the hair of the sleepers may not be deranged. The musical instruments of the Fijians are trumpets of conch-shells, flutes made of bamboo, and drums of sonorous wood. Rude pottery made without a wheel and dried in the sun, is made by the women in some of the Islands.

W. H. HARRISON, Reporter.

HONORARY CERTIFICATES.*

147. WARU WERAHIKO MORANGIANGI, Hawke's Bay.—Native Genealogical Staff.

161 to 163. KARAITIANA, Pakowai, near Napier.—Flax Mats, &c. of Native manufacture.

167. TARAHA, Pah Waikairo, near Napier.—Maori Mats and Weapons.

232 to 239. HOHEPA TAMAIHENGIA, Porirua.—Maori Curiosities.

240, 241. WAITAORO, Hawke's Bay.—Maori Curiosities.

243, 244. ORIWIA 'TE HURUMUTU,' Hawke's Bay.—Maori Curiosities.

* In making awards in this Class, it was decided by the Commissioners only to grant Honorary Certificates to Maori Exhibitors.—ED.

PRODUCTS AND MANUFACTURES

OF

BRITISH INDIA AND ITS DEPENDENCIES.

A VERY extensive and instructive Collection of the Products and Manufactures of British India and its Dependencies was sent from the India Museum, London, by order of Her Majesty's Secretary of State for India (Sir Charles Wood); the value and interest of which was greatly enhanced by the very complete and excellent Catalogue accompanying it, the work of Dr. J. Forbes Watson, A.M., M.D., &c. &c., Reporter on the Products of India.* This collection numbered 1041 exhibits. †CLASS II.—*Chemical Substances and Products, and Pharmaceutical Processes*, comprises 78 specimens, chiefly of Indian Barks, Roots, Flowers, Seeds, &c. used in medicine. In CLASS III.—*Substances used as Food.* SECTION A.—*Agricultural Produce*, comprises 160 specimens of Cereals, Pulses, Starches, and Spices. Prominent in the *Cereal* group are wheat, maize, millet, rice in great variety, with which is eaten, to supply the nitrogenous or "flesh-forming" material, in which these are defective, the *Pulses*, comprising the Pea and Bean tribes. In the former tribe, Gram (*Cicer arietinum*) or Chick pea occupies an important position. It is largely used by the people, and constitutes, besides, the great horse-food of Northern and Western India. It can be used for this purpose for a length of time without causing "heating" or the other deleterious effects ordinarily produced by the too exclusive employment of peas and beans. The Pigeon pea is a particular favorite; when husked and split, it constitutes the kind of "dhol" which, when procurable, most commonly enters with rice into the formation of the vegetable curry of the Hindoo. Lentils, though cultivated in many parts, are not generally held in high repute in India.

* Most of the information in this notice is derived from Dr. Forbes Watson's Catalogues of the Indian exhibits in the New Zealand Exhibition, and the International Exhibition 1862.—ED.

† The Classes not mentioned were unrepresented in this Collection.—ED.

Beans are largely cultivated, and employed similarly to the pea tribe. *Lablab vulgaris*, of which there are a number of varieties, all favorites, and *Dolichos sinensis* (white, brown, and black), are those chiefly used as articles of human food. The Bhoot or Soy bean (*Soja hispida*), is cultivated in many parts of the North of India. It is the same as the well-known Chinese bean, which constitutes such a large article of trade between the Northern and Southern ports of China. Of all vegetable substances, it is richer in nitrogenous or "flesh-forming" matter than any yet discovered, containing nearly 40 per cent. as the mean of three analyses.* Moot, *Phaseolus aconitifolius*, is extensively cultivated in Oude. When split, it forms one of the "Dâls," and, ground into flour, is used for bread by Natives. It is also sometimes used mixed up with wheaten flour. Bullocks, sheep, goats, and many of the Native cavalry horses are fed on it. Two varieties are cultivated, white and black. The *Starches* include Arrowroot; Tikor, *Curcuma angustifolia;* Tapioca, *Manihot utilissima;* Sago, *Sagus Rumphii*, Pearl, and as Flour from Singapore; and Imitation Sago, *Tacca pinnafitida*, from Mergui. The Spices, &c. include Pepper, *Piper nigrum*, both black and white; Long Pepper, *Chavica officinalis*, from Java; Cardamoms, *Elettaria cardamomum;* Turmeric, *Curcuma longa;* Cinnamon, *Cinnamomum Zeylanicum*, from Singapore; Aniseed, *Pimpinella anisum;* Cloves, *Caryophyllus aromaticus*, from Penang; as were also Nutmegs and Mace, *Myristica moschata;* Ginger, *Zingiber officinale*, and Turmeric, *Curcuma longa*, &c. &c., coming from Hindostan.

SECTION B.—*Substances used in the Preparation of Drinks, &c.* TEAS.—An exhibition of teas from localities other than the well known ones in China possesses more than ordinary interest. The cultivation of the tea plant is being rapidly extended in India, a district exceeding 1000 miles in length being more or less adapted to its growth. The production of tea in Assam has taken very firm root, and is spreading with almost unexampled rapidity. But this cultivation is not confined to Assam; the Government of India having succeeded, through the able agency of Dr. Jameson, in introducing it into Dehra Dhoon, Kumaon, Gurwhal, and Kangra. As the result of this, private enterprise—as represented by a number of individuals and several companies—is now engaged in extending its cultivation in the districts in question. Of what is being done, a very good notion is conveyed by the 127 samples displayed.

* See Table showing results of analyses by Dr. Watson. P. 352.—ED.

The Assam Tea Company has been established since 1839, and now supplies the markets of London and Calcutta with no fewer than 1,000,000 lbs. of tea annually. The plant which is reared in nurseries until it is matured, was first obtained from the shrubs indigenous to the country. It begins to yield in its third year, and attains its maximum production in the seventh. One and the same plant affords the following varieties :— Pekoe, Flowery Pekoe, Orange Pekoe, Souchong, Congou, and Bohea. The kind of tea is determined simply by the number of the sieve through which the dried leaves will pass. The green Teas of Assam differ from China tea in being unfaced and not colored. In Cachar upwards of fifty plantations, containing some thousands of acres, are already said to exist.

Dr. Campbell makes the following interesting remarks on the growth of tea at Darjeeling, where the first trial of the tea plant was made in 1841, with a few seeds grown in Kumaon from China stock. It was quite successful as to its growth, and the quality was approved of by the Assam tea planter who visited Darjeeling in 1846, and made the first tea here. The original plants are now of gigantic size; one is a bush 50 feet in circumference and 20 feet high. Nevertheless, 7000 feet, the elevation of Darjeeling, is too great for profitable planting; the frost kills the seedlings, and there is not a sufficiently rapid succession of leaf in the warm season to make the manufacture pay. At 7500 feet the plant does not thrive at all. Elevations of 4500 feet and under that to 2000, are the best for tea, and from 3000 to 1200 feet will probably be found the best for coffee. Tea and coffee plantations at higher elevations than these may eventually come into occasional use to secure high-flavored produce without reference to profit.

Although experiments continued to be made on the growth of the tea-plant, and seed from Assam and Kumaon was distributed gratuitously by Government, it was not till 1856 that the first plantation was started at Kursing, and another near Darjeeling, by Captain Samler, who was also the first to try coffee. The success in both cases has been complete, and others have followed in the same path. Indeed all that is now required, is careful and liberal encouragement by the Government, to render these hitherto valueless mountains a rich and productive field for European enterprise, a profitable source of pleasant labor to the Hill tribes, and through these channels a source of strength and stability to our power.

The manufacture of tea in Darjeeling begins in April and ends in October. During the period twenty pickings of leaves are reckoned on. The tea of April, May, and October is the finest. The coffee is cured from October to January.

The number of tea plants per acre varies from 1860 to 2700, according as they are placed at 5 or 4 feet apart. The produce of tea per acre looked for from the *first year of manufacture* to the fourth or fifth, when a plantation is at maturity, cannot be correctly estimated. The produce per plant in the fourth year of age is variously estimated at ½ to 3 ounces. Captain Massan, in a memorandum of his operations at Tuckvor, states "he got last season from a few indigenous Assam plants, grown at an elevation of 5000 feet above the sea, *one pound* of manufactured tea from *each tree*. The trees were seven years old." This is an immense return, and not to be reckoned on, on a large scale.

Labor is still abundant, and is likely to continue so from the absence of demand in Eastern Nepaul, the great source of supply. The plantations give steady employment to about 3000 persons, with extra hands occasionally. Wages of Coolies, 4s. 8d. to 5s. per mensem.

Employment on tea and coffee is preferred to that on roads and buildings. Wages of manufacturing Coolies amount to 8 rupees per mensem; that of European assistants to from 100 to 150 rupees; of managers, from 200 to 400, with house, &c.

In Kumaon and Gurwhal, and the Dehrah Dhoon, Government plantations, as well as those of individuals and companies, are to be found. In the year 1861 alone, the Government distributed to private planters throughout Kumaon, Gurwhal, Dehrah Dhoon, and the Punjab, upwards of 130 tons of seed, and 2,400,000 seedlings.

The genuine and wholesome character of these teas, many of them also possessing good flavour and strength, gained for them very favorable notice from the Jurors of the International Exhibition, 1863; and, judging by much of the rubbish mis-called tea exported to the Australian colonies from China, it would be very desirable for our merchants to direct their attention to the qualities obtainable from India.

COFFEE.—Twelve samples of Coffee *(Coffea Arabica)* were exhibited from various parts of India and Penang. In 1860-1, 8535 tons of coffee, of the value of £337,436 were exported from India. European capital is largely employed in promoting the growth of this important berry, by which mountain and forest wastes have been turned into rich productive gardens. In Mysore, whence its cultivation has extended to tens of thousands of acres in other parts of India, the coffee trade bids fair to emulate that of Ceylon, though the average produce per acre is said to be not more than half that of Ceylon. The coffee districts, previously the most wild and desolate parts of Mysore, are now the most prosperous, and the value of the berry has greatly increased. The elevation at which it grows, 3000 to 4000 feet, affords a pleasant, and with ordinary care, a climate well suited to Europeans. The whole of the extensive plantations, according to the traditions of the country, spring from seven coffee berries brought from Mocha by a Mussulman pilgrim named Baba Booden, about 200 years ago, and planted by him near his hermitage, where there are now to be seen some very old coffee trees. But it is only quite of late years that the coffee trade of these districts has become of any magnitude.

SUGAR.—The Date Palm *(Elate sylvestris)* furnishes almost the whole of the sugar exported in such considerable quantities from Calcutta. No good samples of this product were available for the present collection, or procurable in time for shipment. Of cane sugar *(Saccharum officinarum)*

there were five good samples. In 1860-61 India exported 42,299 tons of sugar, of the value of £1,032,416, besides 2730 tons of molasses, or jagree, value £21,501.

Isinglass was represented by one species of fish maw (*Polymenus plebius*), of which India exported to the value of £6401 in 1860-61.

SECTION C.—*Spirits, Intoxicating or Stimulating Drugs, &c.*—None of the various kinds of Spirit, as Arrack, Rum, Mango Spirit, &c., manufactured in India from rice, sugar cane, mango, &c., are included in the collection. Of Opium (*Papaver somniferum*), so largely exported from India (in 1860-61 to the value of £10,184,733, of which China took £9,428,887), there are but two specimens—one from Benares, in the form in which opium is prepared in India for the Chinese markets, bearing the significant designation of "Provision Opium." Three specimens of *Tobacco* (*Nicotiana tabacum*), exported in 1860-61 to the value of £29,783; and one of the celebrated *Bhang, or Indian Hemp (Cannabis sativa).* "The narcotic properties of hemp become concentrated in a resinous juice, which in certain seasons and in tropical countries, exudes and concretes on the leaves, slender stems, and flowers. This constitutes the base of all the hemp preparations, to which all the powers of the drug are attributable. In Central India, the hemp resin, called *churrus*, is collected during the hot season in the following manner:—Men clad in leathern dresses run through the hemp fields, brushing through the plants with all possible violence; the soft resin adheres to the leather, and is subsequently scraped off and kneaded into balls, which sell at from five to six rupees the seer, or about 5s. to 6s. per pound. A still finer kind, the *momeca* or waxen churrus, is collected by the hand in Nepaul, and sells for nearly double the price of the ordinary kind. Dr. M'Kinnon says: 'In Nepaul, the leathern attire is dispensed with, and the resin is collected on the skin of naked coolies.' In Persia the churrus is obtained by pressing the resinous plant on coarse cloths, and then scraping it from these and melting it in a pot with a little warm water. Mirza considers the churrus of Herat the most powerful of all the varieties of the drug. The hemp resin, when pure, is of a blackish grey color, with a fragrant narcotic odour, and a slightly warm, bitterish, acrid, taste."

Of *Betel Nuts* (*Areca catechu*), there are two samples—"The Areca palm, which supplies the betel nut, is known by the Malay name *Pinang*, whence also the name of the island Penang, which is now the chief emporium of the trade. There are various kinds in use, and the mode of preparation also differs. The three ingredients of the betel nut, as com-

monly used, are, the sliced nut, the leaf of the betel pepper in which the nut is rolled, and chunam or powdered lime, which is smeared over the leaf. Professor Johnston calculated that they are chewed by at least fifty millions of the human race."

CLASS 4.—*Animal Oils and Wax* are represented by four samples of *Beeswax* and one of *Fish Oil.*

The *Vegetable Oil Seeds* are of great value to India. In the year 1860-61 no less than 27,535 tons of Linseed (*Linum usitatissimum*) alone, valued at £1,255,779, were exported, besides very large quantities of other oil seeds, of which there are twenty-seven exhibits. The Jholapore and Khandeish Linseed, and the Guzerat Rape Seed (*Sinapis glauca*), are said to be the best in the world.

Of *Vegetable Oils* there are seventeen samples, comprising Linseed, Gingelly, Mustard, Surson, Poppy, Safflower, Ground Nut, &c., &c., oils. Castor Oil (*Ricinus communis*), is only sent as a "lamp oil." The exports of vegetable oils reached £234,379 in 1860-61. There are seven exhibits of *Solid Vegetable Fats*, including Cocoa Nut (*Cocos nucifera*) and other oils. Specimens of *Stearine Candles*, from Cossipore, are also sent. They are hard and of good color. The exports of Wax and Wax Candles for 1860-61 amounted to £27,512. The whole of the exhibits in this section appear to be very deserving of attention.

Animal Substances used in Manufactures.—In New Zealand, of these the chief interest must appertain to *Wool.* In 1850-51 the total exports of wool from India amounted only to 2090 tons, value £68,335; but in 1860-61 they had risen to 9505 tons, value £478,144. Thus, not only had the exports increased four and a half times in weight, but the value of each ton of wool had risen from about £32 15s. to about £50 6s.

"The Bengalee sheep," says Mr P. L. Simmonds, in one of his excellent publications, the 'Animal Products Section of the Kensington Museum Catalogue,' is small, lank, and thin, and the color of three-fourths of each flock is black or dark grey. The quality of the fleece is worse, if possible, than its colour; it is harsh, thin, and hairy in a remarkable degree. The breed on the Coromandel coast is of a still more inferior quality, both in fleece and carcase. . . . . The fleece of the Indian sheep ordinarily weighs but half a pound. Measures have lately been taken to improve the quality of the Punjab wool, in which there is now a brisk export trade *viâ* Kurrachee, reaching 30,000 to 40,000 maunds of about 75lbs. The Yak, or Grunting Ox *(Pœphagus grunniens)* is a small species of ox, having its tail covered with long hair like that of

a horse, and a long mane on its back. Its tail constitutes the Standard still used by the Turks to distinguish their superior officers. The common domestic Goat of Thibet (*Capri changra*) is distinguished by the abundance of its long, flowing, straight hair, which descends below the knees and hocks, and covers the whole animal pretty uniformly. It has long coarse hair at the top, with an exquisite sub-fleece or underdown. The Cashmere or Shawl Goat, so highly prized for its fleece, is descended from the goat of Thibet, which pastures on the Himalayas and is common in the countries west of the Caspian. When picked the wool is soft, rich, and lustrous, and divisible into two or three qualities as exhibited. The kemp is a coarse and harsh straight hair, under which is the soft and beautiful down or wool. Thirty ounces, valued at eight or nine shillings, is required for the manufacture of a shawl a yard and a half square. This shawl wool is obtained from animals found amidst the cold, inhospitable, and arid tracts of Thibet."

The Catalogue states that the following woollen substances are used in the Punjab :—

a. Pashum, or shawl wool, properly so called, being a downy substance found next the skin and below the thick hair of the Thibetan goat. It is of three colours, white, drab, and dark lavender (Tûsha).

The best kind is produced in the semi-Chinese Provinces of Turfan Kichar, and exported *viâ* Yarkand to Kashmere. All the finest shawls are made of this wool, but as the Maharajah of Kashmere keeps a strong monopoly of the article, the Punjab shawl-weavers cannot procure it, and have to be content with an inferior kind of Pashum produced at Châthân, and exported *viâ* Leh to Umritsur, Nûrpûr, Loodianah, Jelalpûr, and other shawl-weaving towns of the Punjab. The price of white Pashum in Kashmere is, for uncleaned, 3s. to 4s. per lb.; ditto cleaned, 6s. to 7s. per lb. Of Tûsha ditto, uncleaned, 2s. to 3s. a lb.; cleaned, from 5s. to 7s.

b. The fleece of the Dumba sheep of Kabul and Peshawur.—This is sometimes called *Kabuli Pashum*. It is used in the manufacture of the finer sorts of chogas, an outer robe or cloak with sleeves, worn by Affghans and other Mahomedans of the Western frontier.

c. Wahab Shâhi, or Kirmani Wool.—The wool of a sheep found in Kirman, a tract of country in the south of Persia, by the Persian Gulf. It is used for the manufacture of a spurious kind of shawl cloth, and for adulterating the texture of Kashmere shawls. Specimens of this wool will be found in the collection.

d. The hair of a goat common in Kabul and Peshawur, called *Pat*, from which a texture called *Pattu* is made.

e. The woolly hair of the camel. From this a coarser kind of choga is made.

f. The wool of the country sheep of the Plains.—Regarding the production of wool in the Himalayan or Sub-Himalayan portion of the Punjab, the last year's Revenue Report states that 'there can be no doubt that the valley of the Sutlej, Ravee, Chandrabaga (or Chenab), Namisukh, and other tributaries of the Indus, supply grazing grounds not to be surpassed in richness and suitableness in any part of the world. The population inhabiting them are chiefly pastoral, but owing to

sloth and ignorance the wool they produce is but small in quantity, full of dirt, and ill-cared for in every way.' The Government of the Punjab have made efforts to improve the breed by the importation of Merino rams, but hitherto with little success. However, a truss of Merino wool produced at Huzara, a hill district to the north-west of the Punjab, and sent to England in 1860, was there valued at 1s. 6d. per lb."

There are thirty-six samples of wool exhibited, comprising sheep and lambs' wool, yak's wool *(Pœphagus grunniens)*, Cashmere, Thibet, and Cabul goat's wool.

SILK.—In the year 1860-61, India exported 873 tons of silk, of the value of £1,036,728; an enormous quantity when it is remembered to be the production of a "*worm*," and that it takes 458 feet 4 inches of spun silk, extracted from a common cocoon of four-casts, to weigh one grain! There are 17 exhibits of silk in the Collection, comprising thread and cocoons of the Eria silkworm (*Attacus Ricini*), of the Moonga silkworm (*Antherœa Assama*), and of the Mezankoorie silkworm (*Antherœa Mezankooria*), all from Assam; also of the Tusseh silkworm (*Antherœa Paphia*), from Bhagulpore, and silk of the mulberry-feeding worm (*Bombyx mori*), from Umritsur and other places. Many other silk-producing moths exist in India, of which an enumeration, by Frederick Moore, Esq., will be found in the "*Technologist*," vol. ii., p. 410.

SECTION C.—*Vegetable Substances used in Manufactures*, includes 29 specimens of *Gums, Resins, &c.* Amongst the more important are the well-known Caoutchouc, from Southern India and Singapore; Gutta-percha (*Isonandra gutta*), a native of the Malayan Peninsula, but not the only tree which yields this plastic gum; Myrrh (*Balsamodendron myrrha*), from Aden; several varieties of Kino (*Butea, sp.*), some specimens containing as much as 75 per cent. of tannin; Gum Benzoin (*Styrax benzoin*), from Sumatra; Olibanum (*Boswellia papyrifera*), from Bombay; and ten samples of that important resin Lac, formed by the insect *Coccus lacca*, which feeds upon various trees in India. Lac is found encircling twigs and branches. The stick lac of commerce consists of the broken twigs with these incrustations, and when purified and the color has been extracted, "shell lac" results. Lac was exported from India in 1860-61 to the extent of 2186 tons, of the value of £171,646. *Dye Stuffs* are well represented. Some fine specimens of Indigo (*Indigofera tinctoria*) are sent from various parts of India, and Madder (*Rubia tinctoria*), from French seed, and that principally exported from India under the name of "Munjeet" (*R. cordifolia*). Of Indigo, India exported in 1860-61 4388 tons, value £1,886,376, and of Munjeet 1244 tons, value £14,379.

Many other dye stuffs are exhibited, and of *Tanning Materials* there are also several representatives. India is very rich in *Fibrous Substances*; foremost among them is Cotton (*Gossypium indicum* and *G. barbadense*). The large and interesting collection of cotton contains 79 specimens, most of which have values affixed to them. In 1860-61 cotton was exported from India to the value of £7,339,862. Since then the trade has been enormously developed, the wisdom of the Government having, by the provision of railways and water carriage, greatly facilitated the means of transport to the coast, and the Civil War in America also caused the most urgent demands for supplies of this almost indispensable fibre to be made on all cotton-producing countries throughout the world. A very useful synopsis of the cotton samples from India, exhibited at the International Exhibition, 1862, will be found in the Reports of the Juries. Other very important fibres are exhibited, for a full description of which the reader is referred to those mines of industrial knowledge, Dr. Forbes Watson's Official Catalogue, and Dr. Royle's work on the "Fibrous Plants of India."

Class XIV.—*Photography.*—There are many exhibits of great interest in this class, especially a number of Portraits of natives of India. These were selected from an extensive series (upwards of 800 different subjects), the originals of which were taken in various parts of India by order of Government, and are now in course of reproduction at the India Museum, with a view to their publication. They are extremely characteristic portraits, and several are very beautiful specimens of photography. It would be well were the Government of New Zealand to order a similar series of Maori portraits, and, indeed, for all Governments with aboriginal subjects, in the interest of ethnographical science, to do the same. There are also photographs of many articles of Indian manufacture, which are also very interesting and instructive.

Class XVIII.—*Cotton*—Includes some very fine *Muslins*, especially those from Dacca, and some *Cotton Piece Goods*. The former were only surpassed in fineness by the very best of the French muslins at the 1862 Exhibition, woven by Monsieur Michon of Tavare; the yarn of which was No. 440, spun by Messrs. T. Houldsworth & Co., Manchester. The "Mulmul Khas," the finest Dacca muslin exhibited, being woven from No. 380 yarn.

Class XX.—*Silk and Velvet*—Included some characteristic specimens from the Punjab and the Madras Presidency.

Class XXI.—*Woollen and Worsted Goods, &c.*, furnishes the great attraction to ladies, eight Cashmere Shawls and one Necktie. These

beautiful manufactures were exported to the value of £151,093 in 1860-61. Some of the specimens sent have lost a portion of their original beauty from having been previously exhibited, but they were not the less greatly admired.

The subjoined remarks on the manufacture of Cashmere shawls were furnished in the report by the Central Committee for the Punjab, to the Exhibition of 1862 :—

This is now by far the most important manufacture in the Punjab; but thirty years ago it was almost entirely confined to Cashmere. At the period alluded to, a terrible famine visited Cashmere; and, in consequence, numbers of the shawl-weavers emigrated to the Punjab, and settled in Umritsur, Nurpûr, Dinangar, Tilaknath, Jelalpûr, and Loodianah, in all of which places the manufacture continues to flourish. The best shawls of Punjab manufacture are manufactured at Umritsur, which is also an emporium of the shawl trade. But none of the shawls made in the Punjab can compete with the best shawls made in Cashmere itself; first, because the Punjab manufacturers are unable to obtain the finest species of wool; and, secondly, by reason of the inferiority of the dyeing, the excellence of which in Cashmere is attributed to some chemical peculiarity in the water there. On receipt of the raw pashum or shawl-wool, the first operation is that of cleaning it; this is done generally by women; the best kind is cleaned with lime and water, but ordinarily the wool is cleaned by being shaken up with flour. The next operation is that of separating the hair from the pashum; this is a tedious operation, and the value of the cloth subsequently manufactured varies with the amount of care bestowed upon it. The wool thus cleaned and sorted is spun into thread with the common "churka," or native spinning-machine. This is also an operation requiring great care. White pashumeea thread of the finest quality will sometimes cost as much as £2 10s. a lb. The thread is next dyed, and is then ready for the loom. The shawls are divided into two great classes—1. Woven shawls, called "Teliwalah." 2. Worked shawls.

Shawls of the former class are woven into separate pieces, which are, when required, sewn together with such precision that the sewing is imperceptible. These are the most highly prized of the two. In worked shawls, the pattern is worked with the needle upon a piece of plain pashumeea or shawl cloth.

A woven shawl made at Cashmere of the best materials, and weighing 7 lbs., will cost in Cashmere as much as £300; of this amount, the cost of the material, including thread, is £30, the wages of labor £100, miscellaneous expenses £50, duty £70.

Besides shawls, various other articles of dress, such as chogas, or outer robes, ladies' opera-cloaks, smoking caps, gloves, &c., are made of pashumeea.

Latterly great complaints have been made by European firms of the adulteration of the texture of Cashmere shawls; and there is no doubt that such adulteration is practised, especially by mixing up Kirmanee wool with real pashum. In order to provide some guarantee against this, it has been proposed that a guild or company of respectable traders should be formed, who should be empowered to affix on all genuine shawls a trade-mark, which should be a guarantee to the public that the material of the shawl is genuine pashum, especially as the Indin Penal Code provides a punishment for those who counterfeit or falsify trade-marks, or knowingly sell goods marked with counterfeit or false trade-marks.

At Delhi shawls are made up of Pashumeea, worked with silk, and embroidered with gold lace. A very delicate shawl is made of the wool of a sheep found in the

neighborhood of Ladak and Kûlu: the best wool is procurable in a village near Rampûr, on the Sutlej; hence the fabric is called "Rampûr chudder." Other woollen manufactures in the Punjab are Peshawur chogas, made of the wool of the Damba sheep, and of camel's hair, and chogas made of Patti, or the hair of the Cabul goat.

CLASS XXII.—*Carpets, Rugs, and Mats,* are but very slightly represented; their importance will, however, well excuse the following excerpt from the Catalogue of the Indian Department of the Exhibition of 1862:—

1. *Carpets.*—The chief places in which carpets are manufactured are Lahore, Meerut, Bareilly, Jubbulpore, Gorruckpore, Mirzapore, Rungpore, and Benares, in the Presidencies of Bengal, the North-west Provinces and the Punjab, and at Masulipatam in the Madras Presidency.

At Lahore, Meerut, and Bareilly, the manufacture is solely carried on by prisoners in the gaols; but as it has only been commenced since the introduction of the new prison discipline, the annual production is limited; so far, however, as quality is concerned, the carpets are excellent. They can be made there of any size and pattern, the average price being from seven to nine shillings per square yard. The great drawback to the exportation of carpets from the above places is the heavy expense of inland transport, which, however, will remedy itself as soon as the three great lines of railway, now in the course of construction, have been completed.

At Jubbulpore the manufacture of carpets, rugs, and suttringees (cotton carpets), has been regularly carried on for years, chiefly in gaol, where Thugs and other prisoners are extensively employed upon them. The Jubbulpore carpets are considered of extremely good texture, and are remarkable for their cheapness. The annual consumption, though large, is limited to a comparatively small area. The nearest place to which they are at present conveyed is Mirzapore, on the Ganges, whence they are forwarded by river boats to Calcutta. The expense of transport from Jubbulpore to Calcutta, including duty and agency charges, &c., is very nearly 90 per cent. on the original cost of the articles at the place of production.

When the railway from Jubbulpore to Bombay is completed, the cost of bringing these carpets to Bombay will be reduced to about 20 per cent. on the cost price, so that a carpet costing at Jubbulpore £10 will be capable of being landed in London for £14 at the outside. The Jubbulpore School of Industry, as it is called, receives direct orders for any amount of carpets, and their fixed prices are as follows:—

Turkey carpets	4R. or 8*s.* per square yard
Scotch carpeting	1R. 8A. or 3*s.* per yard 33 feet wide.
Suttrinjees	1R. 2A. or 2*s.* 3*d.* per square yard
Kidderminster	1R. 2A. or 2*s.* 3*d.* per yard 1 yard wide.

At present, however, the places which supply the greater portion of India, as well as the export demand, are Mirzapore and Benares. There is no specific price per yard, as carpets, both at Mirzapore and Benares, are generally sold at so much a piece. The Mirzapore carpets are noted for their excellent staple and durability of wear, but are dearer than those from Jubbulpore, though for purposes of export they are cheaper, as the place is situated on the Ganges, and has, therefore, the advantage of easy transport to Calcutta. When the railways come into full operation, the carpets of Mirzapore and Benares will be, in all probability, superseded by those of Meerut, Bareilly, Lahore, and Jubbulpore. The manufacture of carpets is also

carried on at Gorruckpore; they are, therefore, more expensive than those of the neighbouring districts of Mirzapore and Benares. In the Madras Presidency, Masulipatam is the chief seat of the manufacture. The trade is carried on to a considerable extent, and entirely by natives, who, as in Bengal, combine it with agricultural undertakings adapted to the season of the year.

The above remarks apply exclusively to carpets not less than 10 feet square.

2. *Rugs.*—The manufacture of rugs is very extensive, and comprises many localities. At Peshawur, Bareilly, Shahpore, Sealcote, and Sirsa, the manufacture is entirely confined to the gaols. The places, however, where a regular manufacture and trade are carried on, are Benares, Mirzapore, Allahabad, and Gorruckpore in Bengal; North Arcot, Tanjore, Ellore, and Malabar in the Madras Presidency; and also at Mysore, as well as at Shikarpore, Kyrpore, and Hyderabad in Sinde. Those of Bengal commend themselves by extraordinary cheapness; they are extensively used throughout India, and also somewhat largely exported. In point of texture and workmanship, however, the rugs from Ellore, Tanjore, and Mysore, though they are comparatively much dearer, are greatly preferred.

The employment of rugs throughout India is most extensive, as every native who can afford to purchase one uses it to sit upon and smoke his hookah. It is impossible to form an estimate of the annual value of this manufacture, as only the small portion exported is entered in the official records, and as no steps have hitherto been taken to ascertain the local trade. The rugs made in Bengal vary in length from 3 to 3½ feet; their average width being 1¾ feet, and their value from £1 to £1 10s. The rugs from Ellore, Tanjore, and Mysore are made of various sizes, and are valued from £2 to £4 each; those from Shikarpore and Kyrpore, as well as from Hyderabad (Sinde) are of a lighter texture, but excellent workmanship; their width is generally uniform, but in length and consequent cost they vary from £2 to £5 each.

The finest articles of this description, however, are the silk rugs from Tanjore and Mysore, the blending of colours and workmanship being excellent. They are made of all sizes, up to even in squares of 10 feet; but being too costly for general adoption, this manufacture is very limited.

3. *Suttringees, or Cotton Carpets and Rugs.*—These fabrics, which are entirely made of cotton, may be considered a cheap substitute for woollen carpets. They are used by everyone, European or native, throughout India, and the annual manufacture is consequently very considerable, especially in Bengal, where they form a large and important branch of inland trade. They are of all sizes, from that of the largest carpet to the smallest rug, but generally of one and the same pattern throughout India, the only difference being the colour. Blue and white, and red and white stripes, constitute the prevalent patterns, but in some, one color of darker and lighter hues is employed. In Meerut, Bareilly, and Patna, new patterns have of late been tried with considerable success, but though preferred by the Europeans, are not by natives, who like the striped patterns because they wear better in daily use, and do not lose the freshness of color by washing. The principal localities where suttringees are manufactured are Agra, Bareilly, Patna, Shahabad, Beerbhoom, and Burdwan. Those manufactured at Agra are considered the best, and the value of its annual production is about £10,000. In Shahabad the quantity manufactured last year was nearly £7000; and the same may be assumed to have been produced in the other places above mentioned. Suttringees vary in price according to size and quality. The small ones are valued from 3s. to 15s., and the larger ones (carpet size) from £1 10s. to £4, the price in many cases being regulated by weight.

4. *Mats.*—The internal trade in mats is very extensive, as they are in universal use by both Europeans and natives and are therefore made of kinds and varieties to suit everybody's taste and means. Europeans use only the better kinds of mats, and almost exclusively for the covering of floors in their houses, but natives employ them for a variety of other purposes, such as to sleep upon, smoke, &c. Every Mahomedan, however poor, after having performed the prescribed ablutions, spreads a small mat before him while saying his prayers. The Hindoo uses it as a sort of table-cloth; in many a poor hut it constitutes the only piece of furniture perceptible.

Though mats are made in almost every part of India, the finest kinds are manufactured at Midnapore, near Calcutta. These are only manufactured to special order, but can be made of any size required. The price varies according to the size of the border, which is coloured either red or black. But besides these extremely fine mats, a description is manufactured of which considerable numbers are exported to Madras, Bombay, Mauritius, and South Australia; these are much cheaper, and a good strong mat about 20 feet square, may be had for £4 if plain, and £5 10s. with a black or red border. The mats next in point of fineness are those from Jessore, also in the vicinity of Calcutta, and called Sittulputtee; these, however, are never made, if Indian, of the size of an entire room floor, but only in the shape of rugs, and have invariably a red border, sometimes also a red flowered centre. They are generally made about four or five feet long and two broad, and cost from £2 to £3 each. At Hooghly, near Calcutta, an inferior kind of small mat is made, of which very large quantities are exported by the emigrants to Mauritius and Demerara, and lately several shipments have been made to New South Wales. The largest variety of small mats is, however, made in the Madras Presidency; North Arcot, and the whole of the Malabar coast, are celebrated for these handsome fabrics. There are at least 200 varieties of design and colouring, the price varying from 3s. to £3 per mat, according to quality and length. All mats in India are made by a special caste, who devote themselves exclusively to that description of manufacture. There are no statistical records to show the number and value of mats annually manufactured, but if it be considered that everybody, high or low, rich or poor, uses some kind of mat, it can easily be imagined that a very large number of people must be employed in making mats to supply the demand, not only of the immense local population, but also that for export.

Class XXIII.—*Specimens of Printing and Dyeing.*—Contains nothing of importance.

Class XXIV.—*Tapestry, Lace, and Embroidery.*—Has some beautiful specimens of Embroidery on muslin, cotton and silk, and net. A Scarf of pine apple fibre (*Ananapa sativa*), embroidered, was universally admired.

Class XXVII.—*Articles of Clothing*—Also contains some very fine examples of Embroidery with silk and gold, and which were also very much admired, in Turban pieces from Gwalior and the Deccan, Caps from Delhi, &c., Kerchiefs from Madras, Garland of State, or "Gatahars," from Lucknow, Scarfs from the Punjab, "Doputtas" and "Dhootees" from Bengal, &c., "Salendongs" from the Malay Peninsula, "Sarees" (girls garments) from Bengal and Bombay, Silk Shirt from Burmah, a "Choga,' or jacket, of brocade or "kincob," usually worn by natives of rank, from

Delhi, and one of crimson Cashmere fabric from Cashmere. Two Umbrellas were also exhibited in this class, one from Sattara, the other from Scinde.

CLASS XXVIII.—*Papers.*—Thirty-seven varieties of Paper are included in the Collection, which are very interesting on account of the different materials used in their manufacture; amongst them old hemp; old records; old gunny bags and aloe fibre; aloe rope, ochro, and sorghum; waste silk; Nepal paper from *Daphne cannabina*; Pulas tree bark (*Butea frondosa*); screw pine leaves (*Pandanus odoratissimus*); and Catechu (*Acacia catechu*).

CLASS XXX.—*Furniture, &c.*—Contains a very miscellaneous collection, such as Boxes, Vases, Cigar Cases, Balls, Plates, &c., &c., illustrating the great skill of the natives of India in the decoration of such articles.

CLASS XXXI.—*Iron and General Hardware.*—Is represented by Pewter vessels; Zinc Hookah and apparatus, and Water Bottle; Brass Plates, Dishes, Vessels, Jumboo (for holding water), Drinking Vessels, Hookah bottom and Bells; and a Copper "Jumboo." Like other Eastern nations the natives of India are remarkable for the classical beauty of many of their articles for domestic use made of the commonest materials. Their metallic vessels are also frequently very elaborately engraved.

CLASS XXXV.—*Manufactures not included in previous Classes.*—Includes Baskets from Madras and the other Presidencies; Fans of palm leaf and of "cuscus" (*Andropogon muricatus*); a scented grass from Madras; Ivory Combs, and a Strainer of cocoa-nut shell.

In the *Fine Arts Department* are a number of Paintings on mica, illustrating the different modes of conveyance in India; the occupations and pastimes of the Hindoos; and their musicians and religious ceremonies. These well-known beautiful and characteristic works are extremely interesting as giving vivid representations of the habits and customs of the people. There are also, a series well described in the catalogue as "Curious drawings, compositions of a Mythological character, in which animals are formed by grouping female figures in various attitudes;" and others of the Rock Temple at Madura, Madras.

A most beautiful Cigar-case, a Walking-stick, and a Glove-box, carved in sandalwood, are also exhibited from Madras. The skill and patience displayed by the natives of India in the carving of these and other articles is well known, and the designs are not only very elaborate, but display very considerable beauty

In closing this synopsis of the Indian collection, the reporter is painfully conscious of how little justice he has been able to render to the splendid industrial resources, or the valuable and beautiful manufactures of India; he cannot, however, but hope that, with regard to the former, our merchants will embrace the opportunity afforded them, by the handsome donation of the Secretary of State for India of most of the products and some of the manufactures exhibited, through the Commissioners, to the Colonial Museum of New Zealand at Wellington, where they are now displayed, of carefully elaborating those articles which could usefully be made articles of direct trade between the two countries; and he would especially draw their attention to the grains, pulses, teas, coffees, spices, gums, drugs, oils, &c., amongst raw products; and the carpets, rugs, &c., amongst manufactures. He would, also, especially commend to the attention of the Government of New Zealand the example of the Indian Government in establishing in London, the centre of commerce and civilization, the Indian Museum, where not only can European manufacturers and others view the products and manufactures of India, but receive from the accomplished Reporter on the products of India, Dr. Forbes Watson, such full, both scientific and commercial, information as can alone be given when its preparation is entrusted to a special Department. It was one of the intentions of the Promoters to cull from the New Zealand Exhibition the materials to form a New Zealand Industrial Museum in London; but want of sufficient funds prevented this desirable object being carried out, it remains, therefore, still to be accomplished; and it is believed that such a Museum would be more beneficial to the Colony than all the "Emigration Pamphlets" that were ever written, for it would have for its motto, "FACTIS, NON VERBIS."

TABLE SHOWING RESULTS OF ANALYSES (By J. Forbes Watson, A.M., M.D., Reporter on the Products of India), of some of the "Substances used for Food" in India. Prepared from the "Catalogue of Indian Exhibits, New Zealand Exhibition, 1865."

COMPOSITION.	CEREALS.							PULSES.													
								PEA TRIBE.					BEAN TRIBE.								
	Wheat, *Triticum vulgare*	Maize, *Zea mays*	Cholum, *Sorghum vulgare*	Cumboo, *Penicillaria spicata*	Tipsoo, *Panicum miliaceum* "Millet."	Raggy, *Eleusine coracana*	Rice, *Oryza sativa*	Chick Pea or Bengal Gram, *Cicer arietinum*	Pigeon Pea, *Cajanus indicus*	Common White Pea, *Pisum sativum*	Grey or Field Pea, *Pisum arvense*	Lentils, *Ervum lens*, (unhusked)	Whal, *Lablab vulgaris*	Chowlee, *Dolichos sinensis*	Cooltee or Madras Horse Gram, *Dolichos uniflorus*	Bhoot or Soy Bean, *Soja hispida*	Green Gram, *Phaseolus radiatus*	Black Gram, unhusked, *Phaseolus mungo*	Black Gram, husked as "Dhol," *Phaseolus mungo*	Moot, *Phaseolus aconitifolius*
Moisture .. .. .. per cent	12·30	12·90	12·35	11·34	12·00	11·58	13·10	10·79	11·96	12·70	12·60	12·70	10·81	12·44	11·40	8·83	11·00	9·20	12·90	11·22
Nitrogenous Matter ,,	13·61	9·23	9·35	10·34	12·60	5·88	7·55	20·08	20·13	25·20	21·80	24·57	24·55	24·00	23·25	39·97	22·46	24·70	23·54	23·90
Starchy Matter ,,	71·22	74·63	74·62	73·03	70·43	79·31	78·05	61·59	63·12	58·38	62·19	59·43	60·81	59·02	61·43	30·48	62·16	60·86	59·38	60·78
Fatty or Oily Matter ,,	1·13	1·59	2.02	3·29	3·62	0·85	0·55	4·57	1·56	1·10	1·12	1·01	0·81	1·41	0·82	16·30	1·46	1·48	1·11	0·64
Mineral Constituents (ash),,	1·74	1·66	1·66	2·00	1·35	2·38	0·75	2·97	3·23	2·53	2·29	2·29	3·02	3·13	3·10	4·42	2·91	3·26	3·07	3·56
TOTALS	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

INTER-COLONIAL LIVE STOCK SHOW

OF THE

NEW ZEALAND EXHIBITION, 1865.

UNDER THE MANAGEMENT OF

MESSRS. DRIVER, MACLEAN, & CO., DUNEDIN.

THE *original* scheme of the New Zealand Exhibition included in its objects, in addition to the more usual exhibits, those of LIVE STOCK and LIVING PLANTS, and this the Promoters in their report to the Commissioners advocated, in order that the Exhibition should be made as complete an exhibition of the resources of New Zealand as possible. As Live Stock and Living Plants could not, however, be admitted amongst the general exhibits, the Commissioners determined to organize separate exhibitions of them, requesting aid in the one from the Agricultural and Pastoral, and in the other from the Horticultural, Societies. But, though the Commissioners took immediate steps to further these projects, they found it so difficult to accomplish them, and the work of carrying out *the* Exhibition became so pressing, that they had almost abandoned the idea, when Messrs. Driver and Maclean, of Dunedin, with great public spirit and liberality, offered not only to take all the labor of organizing an Exhibition of Live Stock upon themselves, but also to be at the whole cost of it, provided only the Commissioners would sanction it, appoint the Judges of the various Classes, and give Honorary Certificates to exhibitors adjudged deserving of them. Messrs. Driver and Maclean at the same time most handsomely expressed their intention, in addition to the Honorary Certificates, to place at the disposal of the judges one gold and a number of silver Medals, for award to the most meritorious exhibitors.

The value and importance to a Colony like New Zealand of such exhibitions of stock can hardly be over-estimated, leading, as they do, to the introduction of the most esteemed breeds of animals from other countries, and their careful management when here, with special regard to colonial requirements; and the Commissioners gladly accepted Messrs. Driver and Maclean's very handsome offer. Those gentlemen have since not only received the cordial thanks of the Commissioners for the admirable manner in which they carried out the exhibition; but to each of them has been awarded a silver medal—"For the valuable services rendered to the New Zealand Exhibition, 1865, by their excellent and liberal management of the Inter-Colonial Live Stock Show held in connection with it, and their handsome provision of Medals for the successful exhibitors thereat."

Sheep, Cattle, Horses, Pigs, and Poultry formed the five grand divisions of the Exhibition, each of which was subdivided into numerous classes.

Sheep.

The value of careful selection and breeding is shown to a very high degree in sheep. Like the late Sir Robert Peel's celebrated question, "What is a pound?" What is a sheep? is a very difficult question to answer in few words, for wild sheep and wild goats so closely resemble each other that naturalists have great difficulty in distinguishing between them. Yet any one of the pure breeds of the present day, of either long or short-woolled sheep, is so utterly unlike any breed of goats that it seems almost impossible even their remotest ancestors could have in any way resembled goats. The improvement of sheep has probably occupied the attention of man ever since the time when Abel was "a keeper of sheep and Cain was a tiller of the ground," and at no other time of the world's history have finer or more valuable breeds existed than at the present moment. At first sheep were looked to only to supply milk for food and skins for clothing, but the felting properties of wool detached from the pelt soon attracted attention, and it is probable that mutton was used for food very soon after the Deluge, though except in Great Britain and some of her dependencies it does not seem, even in recent times, to have been very generally esteemed. The objects of the sheep breeder are perfection and quality in the fleece and flesh of the animal; and, as has been well said by Lord Somerville, "The breed of sheep which on any given quantity of land will carry for a continuance the most wool as well as flesh, and both of the highest quality, is the

breed to be preferred, or which has arrived nearest to perfection." Whether he shall breed with a view to wool alone, or mutton alone, or endeavour to secure both, must very much depend on the markets on which the breeder relies for the sale of his produce. In a densely peopled country where mutton is highly esteemed and is a staple article of diet, the carcase is of such paramount importance that the chief efforts of the breeder are directed to securing early maturity in sheep that have well flavoured meat, fatten quickly with but a small portion of offal, and return most money for the quantity of food consumed by them. But in a sparsely populated country like New Zealand, which in 1864 contained in the Middle Island 36½ sheep to every man, woman, or child of the population, wool must be the chief object of the sheep-breeder; and he will, until the demand for mutton greatly increases and colonists become more fastidious as to its quality, pay comparatively little attention to the carcase. Nevertheless, in the peculiar circumstances of the New Zealand sheep farmer there is perhaps no sheep in the world better, or even so well, adapted for his purpose as the MERINO, which undoubtedly is the breed at present of the greatest importance to the colony. The sheep whence the Merinos take their origin are said by Mr Luccock to be traceable to those on which Jacob experimented when in the service of Laban! The original sheep were of a uniform brown or dingy black color, and the exceptions were accidental and few in number. From the experiments of Jacob a new colour arose, which, by selection from those which had most white about them, at length produced, in the time of David, fleeces purely white. This variety soon diffused itself southward to the Nile, and northward, by the banks of the Euphrates and the Phasis, to the fertile country at the feet of the mountains of Colchis, now Mingrelia and Georgia. Five hundred years afterwards the Greeks invaded Colchis, and carried away the "golden fleece." This was not, says Mr Youatt, valuable, as some have feigned, on account of the particles of gold which, brought down by the torrents from Mount Caucasus, were collected in the fleeces of sheep that were sunk in the streams in order to receive them, but from its own intrinsic excellence; and it has been, and will continue to be, a mine of gold to every country in which it is found, and its worth duly estimated. This celebrated Argonautic expedition laid the foundation of the splendour of the Grecian Republics, and from Greece these sheep were imported by Greek colonists into southern Italy, their wool being very highly prized by the Romans. Thence, Columella, a colonist from Italy, A.D. 41, introduced them into Spain; and thus, and

by the importation of some sheep from Africa, laid the foundation of a general improvement of both short and long-woolled Spanish sheep.

The Saracens fostered the breed of short or fine-woolled sheep in Spain, and in the thirteenth century Seville alone possessed 16,000 looms, but the Catholic Ferdinand and his successor Philip III, drove away the Moors, and with them the woollen manufacture, which has never revived in Spain. But the valuable fine-woolled sheep which the Moorish manufactures had fostered, fortunately survived, and until little more than a century ago Spain could boast in her Merino that she exclusively possessed the best fine-woolled sheep in existence. Spanish sheep are divided into the *estantes*, or stationary, that always remain in one place, and the *transhumantes*, or migratory, that twice a year are taken journies of several hundred miles in search of pasture. The *stationary* are of two breeds—the *Chunah*, of African blood, entirely distinct from and larger and heavier than the Merino, with a much coarser and less valuable wool, having a staple eight inches long—and *true Merinos*. Between these are various mixed breeds, some of which are substituted for pure Merinos when the Merino blood preponderates in them. It is to the *transhumantes*, or migratory Merinos, which summer on the mountains and winter in the plains in the south of Spain, that other countries owe their merino flocks. In 1723 Mr. Alstroemer imported a small flock of Merinos into Sweden, where flock-owners, by great care and much housing, have succeeded in retaining the original form and original soft fine fleece, and gaining somewhat in size and hardihood. In 1765 the Elector imported one hundred rams and two hundred ewes from the best Spanish flocks, and the pure Merino rapidly multiplied, and became perfectly naturalised in Saxony. Very great care is taken by the Saxon sheep-breeders in the selection of their lambs for breeding purposes. Mr C. Howard says, "When the lambs are weaned, each in his turn is placed upon a table, that his wool and form may be minutely observed. The finest are selected for breeding, and receive a *first* mark. When they are one year old, and prior to shearing them, another close examination of those previously marked takes place; those in which no defect can be found receive a *second* mark, and the rest are condemned. A few months afterwards a third and last scrutiny is made; the prime rams and ewes receive a *third* and final mark, but the slightest blemish is sufficient to cause the rejection of the animal. Each breeder of note has a seal or mark secured to the neck of his sheep, to detach or forge which is considered a high crime and punished severely." To this continued extremely careful selection of

animals for breeding stock, and very artificial treatment as to housing, &c., must be attributed the high reputation for the exceeding fineness of their wool which the Saxony or *Escurial* Merinos continue to maintain. In 1778 M. Fink, of the Duchy of Magdeburgh imported some pure Merinos from Spain, and they were subsequently introduced into Hungary and other parts of Austria. These last direct importations from Spain were of the *Negretti* breed, the largest and strongest of all the Spanish travelling sheep.

In 1786, Louis XVI. of France obtained from the King of Spain 383 prime Merinos from the most celebrated flocks. "These sheep," says Baron Daurier, the Director of the Imperial Flocks of Rambouillet, "have, with the utmost vigilance, been kept perfectly free from all crossing or mixture with either foreign or native races, so that they are of perfectly *pure blood.* They have gradually gained in width and size without having long legs; their weights are nearly doubled; their forms, which were angular, have become round and ample; the bones, which were thick, have become thinner; the fleece is more abundant, more compact and thick (*tassè*), and has considerably increased in weight." The *Rambouillets* are the largest breed of pure Merinos.

George III. also obtained, in 1791, a small flock of *Negretti* Merinos from the King of Spain, and their wool was unaffected by the change of climate. But, as they are not good mutton sheep, they were never really liked in England, and the chief merit of the Royal flock is that they are the original parents of the present enormous flocks of Australasian Merinos. What the Argonautic expedition did for Greece, and Columella for Spain, Captain McArthur did for Australasia, and no notice of Australasian sheep can ever be written without honoring his name, who, in 1797, laid the foundation of so much wealth both for these Colonies and England, by obtaining from King George III. only three rams from his flock of pure Spanish Merinos, wherewith to cross some East Indian ewes which he already had. Notwithstanding the mongrel breed of the ewes, the third or fourth cross produced an animal with a fleece equal to that of the pure Merino in Europe. McArthur subsequently imported some sheep direct from Germany, and his example has been followed from time to time by others, so that now some of the very best sheep of all classes of Merinos are to be found in these colonies, and finer animals of this valuable breed of sheep could hardly anywhere be found than some of those at the Inter-Colonial Stock Show of the New Zealand Exhibition. *Facile princeps* amongst the exhibitors of Merino sheep was Mr. F. D. Rich, Bushy Park,

Otago, who carried off all the prizes in the eight classes for Merinos, except the second in Class V., which was awarded to Messrs. W. Degraves and Co., Coliban Park, Victoria, for three two-toothed rams. Liberal outlay to procure the very best blood that Spain or Germany could furnish, combined with the most unremitting care and excellent judgment in the selection of animals from which to breed, on the part of the late Mr. George Rich and his son, has in the fine climate of New Zealand produced a flock of pure bred Spanish Merinos that vies with the best of those in Europe—one that has lately, indeed, as mentioned at page 98, been resorted to by the Director of the Imperial Flocks of Rambouillet for rams wherewith to improve that celebrated stock. Of Mr. Rich's Rams in Class I. the Judges had but one opinion—that they were the finest pen of rams they had ever seen, whether for weight of fleece, fineness and length of staple, or general character of the sheep. Mr. Smith's (Tokomairiro) Rams were also much admired, but somewhat lacked character, and probably not quite so much care had been taken in preserving their fleeces. Mr. Rich's Ewes were also so good as to deserve all the honor that could be bestowed on them, and Mr. Caverhill and Mr. Buckland both deserve mention for the high character of their sheep. In Class 5, Messrs. Degraves and Co's (Coliban Park, Victoria) pen of *Rambouillet* rams were very fine sheep, and secured the second prize. The Intercolonial Exhibition of Merino Wool, held at Melbourne, went to establish the fame of the *Rambouillets,* as sheep of that description bred with the object of getting the heaviest fleece with as great a degree of fineness as is compatible with this, but never sacrificing weight and length of staple to fineness, were decidedly the most successful. Archdeacon Hadfield's pen of German Merinos, and the pens of Messrs. Buckland and Maclanachan also deserved commendation. In Class 7, amongst many exhibitors, Mr. Rich still kept the lead; but Archdeacon Hadfield's was a magnificent animal, out of a pure Saxony Merino ewe of Zadegast's flock, by a pure ram from Fryer's Mecklenburgh flock.

Before leaving the Merinos it may not be useless to call the attention of our flockmasters to the United States as a country into which Merinos of undoubted blood have been very successfully introduced. Great attention has been paid to them, and American wool now surpasses many foreign Merino wools for its felting properties, samples containing 2552 serrations to the inch. It is also very fine, for the diameters of sixteen samples in the Kensington Museum are given in the Catalogue as varying from $\frac{1}{1171}$ to $\frac{1}{1875}$ of an inch. In some very elaborate experiments

lately made before the New York State Sheep-breeders' Association, the difference between greasy and scoured wool varied from 71 to over 50 per cent.; or, taking the average of the experiments as 60 per cent., a loss of upwards of 5lbs. out of a fleece weighing 8¾lbs. in the grease. As a writer in "The Australasian" very pertinently remarks, "this great secretion of yolk is one reason why Merinos are such great eaters in proportion to their size, and why the best woolled ones put on flesh so slowly." In the easier fattened *Cotswold* the difference between the weight of the greasy and scoured fleece was but 18 per cent. It would therefore appear that Merinos carry their grease or fat in the fleece as yolk, *external* to the pelt, whilst the long-woolled sheep put on their fat *internally*. The per centage of scoured wool to live-weight of the animal varied in the Merinos from 4.7lbs. to 9.6lbs., and in the Cotswold was 8lbs. The greatest weight of Merino fleece shorn was 20.91lbs., which yielded 6.56lbs. of scoured wool; the lightest fleece weighed 7.03lbs., and yielded 2.28lbs. of scoured wool. The Cotswold fleece weighed 8.90lbs., and yielded 7.31lbs. of scoured wool. The scouring was "such as is necessary for the manufacturer to fit the wool for taking colours in dyeing." It is to be hoped that this interesting Report will evoke others recording similarly elaborate experiments, as the questions involved are of the highest importance both to wool-growers and wool-buyers.

CLASS IX—brought thirteen competitors forward for the prizes for the best *Leicester Rams*. Mr George Murray's sheep were magnificent animals. Mr Murray had the breed before coming to New Zealand, and took prizes in England, Scotland, France, and America. Since their arrival in this colony the sheep have greatly improved, and for symmetry and fineness, length of staple, and lustre of wool could hardly be excelled. A cross between the Leicester ram and Merino ewe has been found profitable—more so than with the Cheviot or Southdown and Merino, as in the former case a better class of wool and more of it is the result, the constitution is sound, the animal comes early to maturity, the mutton fine, and the increase rapid.

In CLASS X, for *Leicester Ewes*—Mr George Murray took the first, and Mr J. Grigg, of Auckland, the second prize, showing that at both the North and South of New Zealand Leicesters thrive well.

In CLASSES XI. and XII., for *Cotswolds*—it is to be regretted that a breed so old and esteemed should not have been represented.

In CLASSES XIII and XIV, for *Southdowns*—the entries were limited, but the exhibits excellent, some of Messrs Bethune & Hunter's Rams being

equal to any the judges had seen. The proverbial excellence of its mutton still keeps this breed in high favour in England, notwithstanding the shortness of its wool; and when sheep are bred in New Zealand for the table the Southdowns will also become favourites here. In the Ewe class Mr James Smith, Tokomairiro, took the first prize. Mr Buckland exhibited three *Oxford Down Rams*, to which an extra prize was awarded. This is a breed not much known here, but deserving of attention. They are peculiar in producing more mutton and less wool than any other English sheep.

CLASSES XV. and XVI., for *Cheviots*.—Mr. Russell's Rams were just imported from Scotland, and were very fine, as also were Mr Murray's. The Cheviot has not had the attention it deserves from the hands of our Squatters. In some of the exposed districts of this island, where the cold and wet climate militates against the success of the Merino, there is no doubt that the Cheviot would prove a profitable stock. The one great objection is that they require much more shepherding, not being by any means so gregarious as other sheep. The wool of a cross with the Merino fetches a long price, and in some cases, especially in exposed districts, such might be advisable, but, generally speaking, the cross with the Leicester will be found most advantageous. It is true the London judges of the Victorian Intercolonial Exhibition of Merino Wool, and the large French buyers, emphatically condemned the crossing of the fine with the Leicester sheep; but the question for the breeder is, shall he sacrifice weight and length of staple to fineness? If he decides to do so he had better stick to the pure Spanish Merino; but if otherwise, he may console himself for the loss of one class of French buyers by the knowledge that he will have a ready market and excellent prices at Bradford; and if his country is wet, and he crosses with a Romney Marsh sheep, he will obtain, together with immunity from foot-rot, a heavy fleece of fine wool, more lustrous than that from the Leicester cross, and much sought both by Bradford and French buyers. This cross, although not represented in the Live Stock Exhibition, has been very successfully cultivated in New Zealand, especially by Mr Ludlam, Wellington.

In closing this report on the sheep classes, we advise squatters and farmers to adapt their sheep to their country—to consider well the effect of climate, exposure, soil, and pasture, and to select those sheep, whether pure or cross bred, which are most likely to flourish on their land. For the more exposed high grounds, the Cheviot and Cotswold; for the dry and less exposed lands, the Leicester; and for lower marshy situations,

the Romney Marsh or Lincoln crosses with the Merino, would at present appear to promise most if crossing be resorted to. The Agricultural and Pastoral Associations might be the means of diffusing most valuable and exact information on these points so vital to the interests of the Colony, for wool bids fair once more to head the exports of New Zealand.

CATTLE.

Cattle are second only in importance to sheep in New Zealand, and if we have some reason to complain of the quality of the mutton supplied in our towns, we certainly have little occasion to do so of the beef. Cattle thrive well both in the open natural pastures and in the "bush" or forests, where they sometimes disappear for months, feeding on various trees and shrubs. In many districts there exist herds that are wild or nearly so, many of them unbranded, the produce of animals that escaped from cargoes of cattle whilst being landed in the early days of the Colony, or that have wandered from the herds of Squatters, or those running on the Hundreds. These wild, or semi-wild, cattle are very undesirable neighbours to any one who desires to breed pure stock, unless he does so in securely fenced paddocks, as amongst them the bull-calves grow up uncut, and, as they roam about, they not only serve cows, thereby spoiling the purity of the breed, but they also frequently serve young heifers long before they are of a proper age to breed. In this latter case there is not only the damage from the youth of the heifer, but she is ever after unfit to breed pure stock from. It is greatly to be regretted that the stock owners have not paid that attention to purity of breed which it would be their interest to do. It is well known that a mongrel takes more feed than a pure-bred animal, does not come to maturity so early, is not pleasant to the eye, and is not so profitable in any way. Of late, some very fine Short-horns and other pure bred cattle have been imported into the Colony from Great Britain, so that it only requires time and care to produce first-class stock. The Durhams or Short-horns here, as elsewhere, are in great favor, both for dairy and shambles; whilst for the dairy alone Ayrshires are most esteemed. For the team and the butcher the white-faced Herefords are not to be excelled, and the red Devons are hardly second to them; but the Reporter is not aware that any pure specimens of this last splendid breed have yet been brought to the Colony. Still, some of the New Zealand beef is equal to any English beef, though bred and fed on the natural pastures of the Colony, and guiltless of any artificial food whatever, or even English grass.

The practice which obtains amongst Otago teamsters and others

of clothing their horses, when at pasture, with thick canvas covers, lined with woollen cloth, might be very advantageously extended by dairymen to cows. It is well known that when cows are exposed to cold winds and wet, their milk is not only diminished in quantity, but notably lowered in quality; and the reason is obvious—there is an increased necessity for the production of animal heat to withstand the effects of cold and moisture. To produce this, more carbon must be burnt in the lungs, and as the source of that carbon, the food of the animal, cannot supply sufficient to produce this increased animal heat, and the same quantity and quality of milk as before, the creamy portion of the milk is greatly diminished. Dairymen in England, therefore, find it to their interest to house feed the cows, merely allowing them to go out into a paddock for a short time daily in fine weather; but in New Zealand this would be out of the question, and, consequently, the defence against exposure afforded by such covers as are used for horses would be very beneficial—not only would the cows yield more and richer milk, but also consume less food.

Cattle were numerous in the Show-yard, and in Class I., *Bulls (Durham breed), any age.*—Mr. George Murray exhibited a magnificent animal, descended from some of the best English blood. Mr. Robert Graham's Bulls were also very fine, but did not look so well as they otherwise would on account of their voyage from Auckland.

Class II., *Cows (Durham breed), any age.*—There were some good ordinary animals, with no pretension to very high blood.

Class III., *Bulls, any breed.*—Mr. James Kennedy's *Ayrshire* Bull was a splendid beast—one of a class that is now coming into great repute amongst our farmers. The Ayrshire has its own place, and that is the dairy farm, where it has been proved beyond a doubt to be the most profitable. Mr. George Murray's and Mr. Robert Graham's *Durhams*, however, secured both the first and the second prizes.

Class IV., *Cows, any breed.*—There were very numerous exhibits in this class. Mr. Strode's and Mr. James Allen's cows were awarded the prizes: both were very fine animals, but hardly having the character we should like to see in animals with pretensions to pure breeding.

Class V., *Cows for Dairy Purposes.*—Mr. David Warnock's *Ayrshire* was quite a model of her class.

Class VII., *Heifers, under three years, any breed.*—Mr. James Kennedy's and Mr. David Warnock's *Ayrshire* Heifers were beautiful animals, possessing all the points characteristic of that breed: the delicate and

beautifully-rounded horns, clear large eye, small head, long neck, fine bone, clean shoulder, well-set and capacious milk vessel, and soft silky skin.

Class X., *Fat Oxen, pair.*—Phillips, Parsons, & Co. exhibited two really magnificent animals.

HORSES.

Wherever Englishmen go they carry with them a love for horse-flesh, and, with an acquaintance with it commencing often before they leave the nursery, it is not surprising that, as soon as they colonise a new country, they immediately set about getting horses of every description—draught, hack, and thorough-bred. So it was in New Zealand, and Australia being the nearest horse-breeding country, most of the original stock in this Colony were imported thence. These importations have at the present time so greatly diminished that they may almost be said to have ceased; and beyond drawing a few entires and brood mares of pure blood for breeding purposes from Great Britain, Australia, and India, it is probable that New Zealand will in future depend for her horse-flesh upon stock bred in the Colony. Fortunately the climate of New Zealand is eminently congenial to the horse, no better proof of which can be given than the distances common hacks are often ridden for days together without a sight of corn—distances that "at home" would be chronicled were they performed by the highly-fed, well-conditioned English hacks, instead of the rough-and-ready, ragged New Zealanders, fed only upon the natural pasture, and not too much of that. Scrubbers that would not in England be considered fit for a butcher's boy, would kill many a daintily-kept, fashionable hack there with one week of their ordinary work.

It only requires care on the part of breeders in the selection of their breeding stock, to ensure that horses for every purpose shall be produced in New Zealand, equal to any in the world. On the principle that "handsome is that handsome does," we have, as before remarked, little reason to complain of our horses, but with their present endurance and hardiness, somewhat more symmetry and more defined paces would be no disadvantage. The practice, too often followed, of allowing mares to run wild on the stations, while entires are permitted to roam about the country, must make much of the breeding a matter of chance medley, and cannot be sufficiently deprecated. Many a young mare is spoilt for breeding by her first foal being got by some worthless brute with whom to be seen should be to be destroyed. The mischief such an animal does

is not confined to his own progeny, for the mare is ever afterwards unfit to breed from, as her offspring even to another well-bred horse, will show, in too many instances, the stain of the first one; and whilst so little land is enclosed in the Colony it should be highly penal for any one owning a stallion to permit him, under any circumstances, to be at large. With regard to thorough-bred horses, a reference to the New Zealand Stud-book* will show that the Colony possesses some 150 brood mares, of which about 30 are known to be thoroughbred, and the remainder supposed to be so, although their pedigrees are imperfect; and about 60 covering stallions, of which about two-thirds are thoroughbred and the remainder supposed to be so. These animals include amongst them some with famous English blood, and as further importations are made yearly, after a while we may hope to see some first-rate N. Z. bred horses. Some very fine draught horses and mares have also been imported, chiefly of *Clydesdale* blood, and in Class I., *Imported Draught Stallions*, the exhibition was probably the best that has ever taken place in New Zealand. Mr. Robert Miller's (Tokomairiro) "Sir William Wallace" was a horse of immense power, rare action, great symmetry, and very mild temper. Mr. Miller's "Lord Paisley," Mr. Nimmo's "Napoleon," and Messrs. Blair and Emery's "Champion," were also all horses of the right stamp, and by sires of note. The Judges placed "Sir William Wallace" first, but many fanciers of Clydesdale horses were rather in favor of "Napoleon."

Class II., *Imported Draught Mares.*—Mr. Nimmo's were pre-eminent amongst imported *Clydesdales*; their condition was not very good, but in stamp and conformation they were all that could be desired, with especially deep broad chests, round ribs, and good legs.

Class IV., *Draught Mares bred in New Zealand or Australia.*—Mr. Williamson, North Taieri, and Mr. Cullen, Dunedin, showed some very fine animals to which prizes were awarded, but some of the others exhibited were not of a class to be commended.

Class V., *Draught Fillies under three years.*—The entries in this Class though not numerous, were good. Mr. Shand, Jun.'s, Roan, and Mr. Barr's Grey, Fillies well deserving Honorary Certificates.

Class VII., *Draught Fillies under two years.*—Mr. J. M. Williamson and Mr. James Cullen, took the prizes with very good animals.

* Compiled by Mr Charles Elliott, Nelson. A very useful publication, and decidedly a step in the right direction.—Ed.

CLASS IX., *Draught Geldings.*—Amongst these were some first-class animals, Mr. Monaghan's and Mr. Robert Morrison's especially.

It is much to be regretted that the Show-yard was very bare of thorough-bred stock, and beyond a promising-looking Mare of Mr. Henry Driver's in Class XIII., there was nothing to remark upon.

CLASS XVIII., *Weight Carrying Hacks.*—Mr. Francis Fulton showed a handsome animal, docile, and up to any weight.

CLASS XX., *Ponies.*—These were as a class good, particularly noticeable amongst them being Capt. Williams' very diminutive black Entire Pony.

PIGS.

More attention has been paid of late in New Zealand to the breeding of these useful animals, and something like defined breeds are making their appearance, to the displacement of the "Maoris," as the hardy ugly descendants of those put ashore by Captain Cook a century ago are called. Some very good pigs were exhibited, those of the small breed being especially well bred. The prize list will be found below.

POULTRY.

There were numerous and some excellent exhibits of all kinds of Poultry, and some good Pigeons. Mr. Armstrong in the Miscellaneous Class also exhibited an interesting Collection of imported Birds and Animals.

GENERAL ORDER OF MERIT.

SECTION A.—SHEEP.*

MERINOS.

Judges—Wm. Logie, A. Thomson, Watson Shennan.

CLASS.

1.—Three Rams, imported—First and Second, F. D. RICH, Bushy Park, Palmerston.

2.—Three Ewes, imported—1st and 2nd, F. D. RICH.

3.—Three Rams, bred in N. Zealand or Australian Colonies—1st and 2nd, F. D. RICH.

4.—Three Ewes, bred in N. Zealand or Australian Colonies—1st and 2nd, F. D. RICH.

5.—Three two-tooth Rams, bred in New Zealand or Australian Colonies—1st, F. D. RICH; 2nd, WM. DEGRAVES & Co., Coliban Park, Victoria.

6.—Three two-tooth Ewes, bred in New Zealand or Australian Colonies—1st, and 2nd, F. D. RICH.

7.—Any Ram exhibited—1st and 2nd, F. D. RICH.

8.—Any Ewe exhibited—1st and 2nd, —F. D. RICH.

* Note.—When *age* is not mentioned, Stock might be of "any age." When *Classes* are not mentioned in their regular order, there was "no competition" in them.

OTHER SHEEP.

Judges—F. D. Rich, Gerrard Spooner, J. T. Ord.

CLASS.

9.—*Leicester* Ram—1st, GEORGE MURRAY, Taieri; 2nd, J. SHIPHERD, Auckland.

10.—*Leicester* Ewe—1st, GEORGE MURRAY; 2nd, JOHN GRIGG, Auckland.

11.—*Cotswold* Ram—1st, JOHN GRIGG.

13.—*Southdown* Ram—1st, BETHUNE & HUNTER, Wellington; 2nd, JAMES SMITH, Tokomairiro.

14.—*Southdown* Ewe—1st, JAMES SMITH; 2nd, WM. BLACK, Tokomairiro.

15.—*Cheviot* Ram—1st, GEORGE GRAY RUSSELL, Dunedin.

16.—*Cheviot* Ewe—1st, GEORGE MURRAY.

19.—Five Fat Lambs—1st, GEORGE MURRAY.

Extra Stock.—Oxford Down Rams and Ewes—ALFRED BUCKLAND, Auckland.

SECTION B.—CATTLE.

Judges—H. S. Thomson, R. Jopp, F. Wentworth.

1.—Bull, *Durham* breed—1st, GEO. MURRAY; 2nd, ROBERT GRAHAME, Auckland.

2.—Cow, *Durham* breed—1st and 2nd, JAMES ALLEN, Taieri.

3.—Bull of any breed—1st, GEORGE MURRAY; 2nd, ROBERT GRAHAME.

4.—Cow of any breed—1st, A. C. STRODE, Dunedin; 2nd, JAMES ALLEN.

5.—Cow for dairy purposes—1st, DAVID WARNOCK, Dunedin; 2nd, D. BRUNTON.

6.—Bull under 3 years old, of any breed—1st, GEORGE MURRAY; 2nd, R. GRAHAME.

7.—Heifer under 3 years old, of any breed—1st, JAMES KENNEDY, Green Island, Otago; 2nd, DAVID WARNOCK.

9.—Heifer under 2 years old, of any breed—1st, JAMES KENNEDY.

10.—Pair fat Oxen—1st, PHILLIPS, PARSONS & CO., Dunedin.

11.—Pair fat Cows—1st, PHILLIPS, PARSONS & CO.

12.—Pair Working Bullocks—1st, ALEXANDER CALLANDER.

SECTION C.—HORSES.

DRAUGHT HORSES.

Judges—Henry Wilson, R. Jopp, John Duff.

1.—Draught Stallion, imported—1st, ROBERT MILLER, Tokomairiro, "*Sir William Wallace*"; 2nd, Do., "*Lord Paisley*."

2.—Draught Mare, imported—1st and 2nd, JOHN NIMMO, West Taieri.

4.—Draught Mare, bred in New Zealand or Australia—1st, J. M. WILLIAMSON, Taieri; 2nd, J. CULLEN, Taieri.

6.—Draught Filly under 3 years old—1st, GEORGE SHAND, JUN.; 2nd, JOHN BARR, Kaikorai.

8.—Draught Filly under 2 years old—1st, J. M. WILLIAMSON; 2nd, JAMES CULLEN.

9.—Draught Gelding—1st, JOHN MONAGHAN, Dunedin; 2nd, R. MORRISON.

10.—Pair Plough Horses—1st, J. TOMLINSON; 2nd, LONNIE & CO., Dunedin.

THOROUGH-BRED AND OTHER HORSES.

Judges—F. Wentworth, W. D. Murison.

12.—Thorough-bred Stallion, bred in New Zealand or Australia—1st, GEO. THOMSON, "*Roue*," Dunedin; 2nd, CHARLES HOPKINSON, "*Flying Dutchman*."

13.—Thorough-bred Mare, bred in New Zealand or Australia—1st, HENRY DRIVER, "*Evangeline*," Dunedin.

18.—Weight-carrying Hackney—1st, FRANCIS FULTON, Caversham.

20.—Pony under fourteen hands—1st, ANDREW WILSON, Dunedin; 2nd, W. H. REYNOLDS, Dunedin. *Extra*—Shetland Pony—CAPT. WILLIAMSON, Dunedin.

SECTION D.—PIGS.

CLASS.

1.—Boar, large breed—1st, R. B. MARTIN, Dunedin; 2nd, PHILLIPS, PARSONS & Co., Dunedin.

2.—Sow, large breed—1st, GEORGE MURRAY; 2nd, ALEXANDER BEVERIDGE.

3.—Boar, small breed—1st, ALEXANDER BEVERIDGE.

4.—Sow, small breed—1st, R. B. MARTIN; 2nd, JAMES WILSON.

5.—Boar, any breed—1st, ALEXANDER BEVERIDGE; 2nd, R. B. MARTIN.

6.—Sow, any breed—1st, GEORGE MURRAY; 2nd, R. B. MARTIN.

7.—Fat Pig—1st, GEORGE MURRAY; 2nd, R. B. MARTIN.

SECTION E.—POULTRY.

1.—Cock and Pair Hens, *Dorkings*—1st, GEORGE MURRAY; 2nd—DAVID WARNOCK.

2.—Cock and Pair Hens, *Spanish*—1st and 2nd, CUTHBERT NELSON.

4.—Cock and Pair Hens, *Poland*—1st, CUTHBERT NELSON; 2nd—PETER RUSSELL.

5.—Cock and Pair Hens, any other variety—1st and 2nd, WATSON SHENNAN.

6.—Pair Geese—1st, GEORGE MURRAY.

8.—Pair Ducks—1st, GEORGE MURRAY.

Extra.—Collection of Pigeons, WM. SLY. Collection of Rare Animals and Birds, J. P. ARMSTRONG. Pen of Barn-door Fowls, — DYSON.

GOLD MEDAL.

Presented by Messrs. Driver, Maclean, & Co.

F. D. RICH.—For best *Merino* Ram exhibited.

SILVER MEDALS.

Presented by Messrs. Driver, Maclean, & Co.

F. D. RICH.—For best *Merino* Ewe exhibited.

WM. DEGRAVES & Co.—For 2-tooth *Rambouillet* Rams.

GEORGE MURRAY.—For best *Leicester* Ram and Ewe exhibited.

JOHN GRIGG.—For *Leicester* and *Cotswold* Rams and Ewes.

BETHUNE & HUNTER.—For best *Southdown* Ram exhibited.

JAMES SMITH.—For best *Southdown* Ewe exhibited.

GEORGE GRAY RUSSELL.—For best *Cheviot* Ram exhibited.

GEORGE MURRAY.—For best *Durham* Bull exhibited.

ROBERT GRAHAM.—For best *Durham* Bull exhibited.

JAMES ALLEN.—For best *Durham* Cow exhibited.

A. C. STRODE.—For best Cow exhibited.

ROBERT MILLER.—For best Draught Stallion exhibited, "*Sir Wm. Wallace.*"

JOHN NIMMO.—For best Draught Mares exhibited.

GEORGE THOMSON.—For best Thorough-bred Stallion exhibited.

HENRY DRIVER.—For best Thorough-bred Mare exhibited.

HONORARY CERTIFICATES.

F. D. Rich—Superior excellence of *Merino* Rams and Ewes.

Wm. Degraves & Co., Victoria.—Excellence of *Merino* Rams.

George Murray—Superior excellence of *Leicester* Rams and Ewes, and *Short-horn* Cattle.

John Grigg—Superior excellence of *Leicester* Sheep.

T. Shipherd—*Leicester* Rams.

Bethune & Hunter—General excellence of *Southdown* Sheep.

James Smith—General excellence of *Southdown* Sheep.

Wm. Black—*Southdown* Sheep.

George Gray Russell—*Cheviot* Rams.

Alfred Buckland—Excellence of *Oxford Down* Sheep.

James Allen—General excellence of *Durham* Cows.

Robert Graham—General excellence of *Durham* Bulls.

A. C. Strode—Excellence of Cow.

David Warnock—Excellence of *Ayrshire* Dairy Cow.

James Kennedy.—Superior excellence of *Ayrshire* Heifer.

Philips, Parsons & Co.—Fine quality and extraordinary weight of Fat Oxen

Alexander Callander.—Working Bullocks.

Robert Miller.—Superior excellence of Draught Entire Horses.

John Nimmo.—Superior excellence of Draught Mares.

J. M. Williamson.—Excellence of Draught Mares.

George Shand, Jun.—Excellence of Draught Mares.

John Monaghan.—Excellence of Draught Gelding.

J. Tomlinson.—Pair Plough Horses.

George Thomson.—Thorough-bred Entire Horse "*Roué.*"

Henry Driver.—Thorough-bred Chestnut Mare "*Evangeline.*"

Francis Fulton.—Hackney.

Andrew Wilson.—Pony.

R. B. Martin.—Pigs.

TABLE,

COMPILED FROM THE REGISTRAR-GENERAL'S OFFICIAL REPORTS, SHOWING THE NUMBER OF LIVE STOCK IN THE POSSESSION OF EUROPEANS IN EACH ISLAND, AND THE WHOLE OF NEW ZEALAND, IN THE YEARS 1858, 1861, *AND* 1864.

—	Sheep.			Cattle.			Horses.			Mules and Asses.			Pigs.			Goats.			Poultry.		
	1858.	1861.	1864.	1858.	1861.	1864.	1858.	1861.	1864.	1858.	1861.	1864.	1858.	1861.	1864.	1858.	1861.	1864.	1858.	1861.	1864.
Northern Island	411,106	638,768	1,034,097	76,043	96,236	110,273	8,217	12,740	18,355	60	71	212	26,941	26,220	28,689	6,910	9,862	5,808	No Returns.	133,602	163,720
Southern Island	1,112,218	2,121,415	3,900,857	61,161	96,864	139,182	6,695	15,535	31,004	62	82	127	13,793	16,826	32,296	4,887	2,329	6,197		103,060	213,892
Chatham Islands	—	1,400	2,319	—	185	303	—	—	50	—	—	—	—	224	291	—	—	—		436	802
Total in New Zealand ..	1,523,324	2,761,583	4,937,273	137,204	193,285	249,760	14,912	28,275	49,409	122	153	339	40,734	43,270	61,276	11,797	12,191	12,005		236,098	378,414

Z

APPENDIX A.

SUPPLEMENTARY REPORT ON CLASS I.

BY

JAMES HECTOR, M.D., F.R.S.E., *Colonial Geologist for New Zealand:*

AND

WILLIAM SKEY, *Analytical Chemist to the Geological Survey.*

INTRODUCTION.

MANY important Mineral Substances and other raw products were brought together in the Exhibition for the first time, from various parts of New Zealand and the neighboring Colonies, the comparative value of which could only be ascertained by means of chemical analysis.

The following Supplementary Report is intended to supply this information, so far as it could be obtained with the limited means at disposal in the Colony.

Some of the analytical examinations which are given in this Report were made in connection with the Geological Survey of the Province of Otago, during the last three years, upon specimens which, in many cases, were only represented by, but not identical with, those exhibited.

The others of the examinations were made specially for the Commissioners, and at their expense, by Mr. Wm. Skey, now Analyst to the Geological Survey of New Zealand, in the Laboratory at Dunedin, which was placed at his disposal through the courtesy of the Provincial Government.

This Report thus contains some matter that has previously appeared in official reports printed in the Council Papers of the Province of Otago,* and dated 13th

* Since this Report was prepared, a Memoir on the Tertiary Coals of New Zealand has reached me, by Dr. Lauder Lindsay, F.R.S.E., read before the Royal Society of Edinburgh on 20th February, 1865, embodying the analysis and description of the New Zealand Coals, given in the Official Report alluded to. The only important addition which it contains is a Table of the composition of several of the Otago Brown Coals, as ascertained by Professor Murray Thomson of Bengal. In this Table the results are reduced in a different form from that adopted in this Report, giving the percentage of gas and oil in cubic feet and gallons, so that it has been considered advisable to reprint it in that part of the Report relating to this subject. When Professor Thompson's results are comparable with those given in the tables in this Report, they agree fairly, excepting as to the quantity of ash, from which it would appear that Dr. Lindsay's specimens contained considerably above the average quantity.

April, 1864, but in addition many novel and interesting results, that will, it is hoped, be of service in developing the resources of the Colony, not only by giving correct information regarding the comparative value of exhibits, from different localities, of the substances treated of, but also by stimulating to further discoveries.

In the course of these experiments, which were undertaken for obtaining results of practical utility, several phenomena of more purely scientific interest were also discovered by Mr Skey, but which are only briefly alluded to in this Report, as they will be treated of at greater length in special communications to Scientific Societies.

Of these, the most interesting are the properties of solubility and absorption, which he has discovered to be possessed by mineral coal of every degree of constitution, from imperfect lignite up to pure graphite, and the study of which phenomena possesses the highest interest with regard to the consideration of how thick and valuable coal seams are formed, and the manner in which the imperfectly formed "brown" coals of the later geological formation gradually pass into the dense, lustrous, and compact mineral popularly termed "true coal."

The absence of any extensive coal seams in the older geological formations of New Zealand, as yet discovered, and the abundance and variety of coal seams of later date, give unusual interest to this investigation, as bearing directly upon the value of the coals of this colony, and upon the extent of *natural* variation which may exist in the quality of seams which, though found in formations of the same geological age, have been subjected to different influences.

Mr Skey was led to these investigations by the results which he obtained when studying experimentally the manner of combination in which the large percentage of sulphur is contained in some kinds of brown coal, and which proved to be retained in combination with hydrogen as gaseous matter in the substance of the coal. Following up this discovery, he found that brown coal possesses the property of abstracting many substances from solutions, and especially the organic matters that are contained in all native waters, and which, by thus adding to the density and compactness of the brown coal, must, under favourable conditions, gradually improve its character as a fuel, and cause it to pass into the more perfect form of coal. If this view be correct, the conditions necessary for this change do not, as has been generally supposed, require the existence of elevated temperature and immense pressure, but rather a free percolation of water from the surface, and an abundant supply of organic matter with which the water becomes charged. It is, however, unnecessary to allude to these interesting investigations further than to mention them as one of the indirect results of the Exhibition.

Another subject of interest which is only partially treated of in the following Report, is the discovery of several new compounds and reactions of the element Tungsten, which is found in considerable quantity in the neighborhood of the Wakatipu Lake; but these investigations as yet have not acquired any practical value.

The improvement of the method of purifying Graphite by fusion with Alkali, as indicated by Mr. Skey, is also worthy of attention, and will tend to render available the ore of that useful mineral that occurs in the Province of Nelson, but which could not be so profitably worked without some such simple method of preparation.

The investigation of the properties of the New Zealand Flax plant (*Phormium tenax*), received a large share of attention, and it will be seen that the results of the experiments prove that the preparation of the Fibre is beset by mechanical difficulties, and not those of a chemical nature, as has generally been supposed, and there is no reason why the suggestions given in the Report as to the economical preparation of the fibre, should not be practically carried into effect.

Until the cultivation of the New Zealand flax plant is systematically undertaken, and attention paid to the propagation of the varieties that yield the finest fibre, (an art said by some to have been well understood by the Maoris in former times), there is, however, no chance of the profitable production of the fibre as an article of steady export. As long as the wild plant is depended upon for the supply, the gradually increasing expense of collection as the plant gets scarcer, and the capricious variety in the quality of the manufactured fibre, will prevent it acquiring that steady hold on the market to which it is entitled.

It will be observed, however, from the body of the Report, that the study of the properties of the Flax plant, as well as those of the Tutu* plant (*Coriaria*), are not yet completed, but will be resumed on the return of the proper season of the year.

JAMES HECTOR.

I.—COALS.

As there is much misapprehension of the true nature and relative value to be attached to the various kinds of Coal found in New Zealand, arising principally from the fact that their geological age cannot be definitely compared with the true Coal formation in the Northern Hemisphere, it is necessary to preface this account of the Coal exhibits by a brief explanation of the views which are at present accepted concerning the nature and origin of carbonaceous deposits.

The term "Coal" receives a vague application to a variety of substances, which have been produced from the vegetation of past geological ages, by a slow chemical and mechanical change, and which is one of the forms of that process of decay by which all organised substances revert to their inorganic elements. The principal circumstances which determined the production of coal rather than humus or vegetable mould, seemed to have been the exclusion of the atmosphere from the vegetable matter, before true decomposition had commenced. This exclusion was effected when a deposit of sediment, especially that of an argillaceous character, was promptly superimposed upon it in consequence of the depression under water of the area on which the vegetable matter had accumulated.

According to Chemists, the process by which vegetable matter—which consists essentially of carbon, hydrogen, and oxygen—has been converted into coal, depends on the elimination of the oxygen or incombustible element at the expense of a certain portion of the two former. The process is progressive, and the value of the resulting coal depends on the extent to which the concentration of those elements which give it value as fuel, has been effected.

In Nature, therefore, a very complete series of substances represents the various stages of this process,—thus we have WOOD, PEAT, JET, LIGNITE, BITUMINOUS COAL, FREE-BURNING COAL, and ANTHRACITE. In these we have a series, step by step, increasing in the percentage of carbon, and consequently decreasing in the percentage of hydrogen and oxygen—the last-mentioned substance ANTHRACITE being nearly pure carbon; and it is hardly necessary to remark that the carbon and hydrogen are the useful heat-giving constituents of coal, while the presence of oxygen greatly decreases its calorific powers.

The rapidity by which this process has progressed in any given case will depend on various circumstances—such as the manner in which the vegetable matter was de-

* A most interesting account of the Tutu plant, by Dr. Lindsay, has appeared in the *British and Foreign Medico-Chirurgical Review* for July 1865, in which the botanical relations of the plant and the nature of its poisonous effects are treated of at great length.

posited, the degree to which ordinary decomposition had progressed previous to the covering up of the mass, and the amount of pressure and temperature to which it has been subsequently subjected. But all of these conditions are apparently subordinate to the time during which the above process has been in operation, or what is the same thing, to the geological age of the deposit.

Deposits of coal evidently indicate the presence of dry land upon which the vegetation flourished, and from its peculiar botanical character, as well as the frequency and ease with which it had been submerged, it would appear that this land was of a low esturine character, or at any rate was in close proximity to the sea or to large lakes. Consequently, wherever such circumstances existed, coal formations would in all probability result. The popular opinion is, however, that deposits of useful coal are confined to what are known as the "coal measures," at which period of the earth's history conditions highly favorable to the luxuriant growth and preservation of vegetable matter appear to have been more universally distributed on the surface of the globe than at any other epoch of which we have legible records.

Valuable sources of coal, which present only slight differences from true coal, may, however, be found in the newer formations, such as the Oolitic and Cretaceous systems, whilst even the Tertiary strata are remarkable for their local deposits of coal of various degrees of usefulness.

The term "coal proper" is commonly applied to those substances found in the true carboniferous system, while those of a more recent date have been denominated by such vague terms as *lignite* and *brown coal*, the former having reference generally to those varieties presenting evident woody structure, whilst the latter is used by the Germans to include all varieties which are of more recent geological age.

Using the word coal in its widest signification, the varieties which will be referred to in this Report may be conveniently divided into two groups, viz.:—

(1.) LIGNITES and BROWN COAL; (2.) NON-CAKING, and CAKING BITUMINOUS COAL—which distinctions are founded on both their physical and chemical characters, and a consideration of their geological age.

LIGNITE deposits occur in what are obviously old lake basins, scattered over the surface of the primitive slate rocks in the interior of New Zealand. They bear evident signs of having been formed from drift wood, as fragments of trees are of frequent occurrence in which the woody tissue is still quite perfect. In some of those deposits in the province of Otago it is possible to recognise, among other woods, that of a species of *Fagus*, or so called Birch, of New Zealand, a genus of tree which still predominates in the primeval forests of the western seaboard.

These *Lignite deposits* are of recent Tertiary age, being only overlaid by the newer drifts in the form of Brick Clays, Ferruginous Gravels, Silts, and Shingle Terraces.

Lignites are used as fuel in several localities in the interior of Otago, and are not commonly distinguished from the Brown Coals proper. In some cases they burn with great facility, owing to a large quantity of fossil resin which is disseminated throughout them.*

In certain deposits of equivalent age to those containing the lignites, the stems and trunks of trees cemented with silicious chert, are of frequent occurrence, and there is evidence from other sources to prove that the period of this deposit was characterised by an extensive distribution of the forest growth over the mountainous

* For description of the Resin see Art. Resin, *seq.*

regions of the Islands, arising from a great increase of altitude due to a general elevation of the land.

The *Great Brown Coal Formation* underlies the Marine Tertiary Sandstones and Limestones which are so extensively developed throughout New Zealand, but it also occurs in the large basin-like valleys of the interior, where it always forms the floor or base of the Upper Tertiary series, which usually rests on it unconformably. It is the most universally distributed coal formation of New Zealand, and in Otago Province for instance, there is no district that is not within easy distance of a deposit of this coal, or of lignite, so that it has proved most useful as fuel to the miners on the Goldfields, where the supply of timber is so deficient. Notwithstanding this wide distribution, these deposits appear to be detached and local in character, and not portions of an extended and continuous formation. They have, nevertheless, been involved in the later dislocations of the older rocks, a circumstance which has no doubt caused them to vary in their composition and value as fuel. The character and thickness of the Brown Coal Formation varies very much. As a general rule, the lower part is mostly conglomeritic and arenaceous in character, passing upwards into argillaceous strata, which in some districts have the nature of true plastic clays. Its largest development in the Province of Otago is on the East Coast, northward from the Clutha or Molyneux River, where it extends continuously at least over 45 square miles, forming hills from 500 to 1000 feet in height, which are broken into sharp ridges by the out-cropping beds of conglomerate and sandstone. This formation is scarped by the sea for many miles, so that it is probably only the remnant of a much larger basin that stretched to the eastward. In this section many seams of good coal are found, some of them ranging from 18 to 23 feet in thickness—the estimated aggregate thickness being 56 feet. These coal seams have generally a roof of tough shale, but only in few cases do they rest on a stratum of fire-clay, the floor being more usually of a grit or fine-grained conglomerate.

In other parts of Otago and in the Province of Southland, this formation is also extensively met with, but probably its greatest development is in the North Island, where, according to Hochstetter and Crawford, it underlies the immense plains of Marine Tertiary strata which form so large a portion of the surface.

Brown Coals differ in several important particulars from true coal, though whether these differences are essential to their geological age is a question still to be determined. The most characteristic difference consists in the quantity of water which they contain in combination—often reaching to 30 per cent., from 10 to 20 per cent. being usual, while true coal seldom contains more than 5 per cent. This defect should not be overlooked in an estimate of their value; for take an example with 10 per cent.—the fact that every ten tons of coal contain one ton of water does not represent the magnitude of the loss, as this water absorbs a large quantity of the heat produced by the combustion of the nine tons of fuel, in the conversion of the one ton of water into steam.

Notwithstanding its defects, Brown Coal will be yet largely used in this Colony both for domestic and other purposes. The disagreeable smell of creosote and sulphurous gas which some varieties give off in burning, and which forms the strongest objection to their being adopted as a domestic fuel, can be altogether escaped by burning it in a stove possessing a good draught adapted for its use.

It can also be used in this manner more economically than in an open fire place, and in small stoves of the above description a very inferior quality of coal to that which New Zealand possesses is largely consumed in Germany for household purposes.

The principal defect of Brown Coal as a fuel for the purpose of raising steam, arises from its greater bulk in proportion to its weight, and the reduction of its calorific power, owing to the large quantity of water which it contains as previously explained. Both these disadvantages can only be remedied by the use of more than usually capacious furnaces, with close fire bars and wide air passages. In the case of stationary engines this is of course effected, and after a short experience I have little doubt that the stokers would prefer the brown coals to the more bituminous varieties, as they form no clinker, and give a steadier heat with a much less amount of labor.

They can never come, however, into use for steamers or for locomotive engines, where economy of space is the main consideration, as, judging from practical experiments, as well as from examination in the laboratory, the effective power of the bituminous coal is one-fourth more than that of an equal bulk of brown coal. In other words, the quantity of brown coal required to do the same work as 20 tons of bituminous coal would require for storage the same space that would contain 25 tons of the better fuel.

As several patents have been taken out for the purpose of preparing a condensed fuel for steam purposes, from varieties of non-caking coals, it is possible that some adaptation of this process might be applied to the brown coals, by which the water they contain would be driven off and replaced by a small quantity of bituminous matter, that would re-cement them in the form of solid blocks of convenient size and density. Much might also be effected towards improving the form of furnaces, in order to suit the peculiarity of the fuel.

The gas derived from the inferior varieties of brown coal is of very inferior quality, and deficient in rich hydro-carbon: all the varieties can, however, be highly recommended for the purpose of burning bricks and lime.

In describing the Brown Coals that are found in New Zealand, the following classification will be adopted from the portion of Dr. Percy's recent valuable treatise on Metallurgy which relates to fuels. It is founded on their external characters, which, indeed, indicate pretty faithfully the varieties in their composition.

"*(a.) Pitch Coal.*—Compact; occasionally cleaving into prismatic pieces. Fracture, conchoidal; color, pitch black; lustre, waxy or fatty.

"*(b.) Common Brown Coal.*—Compact; generally with slaty cleavage, wood-like structure indistinct. Smooth conchoidal fracture; color, blackish brown to pitch black; lustre, more or less glistening or slightly fatty.

"*(c.) Woody Brown Coal.*—Massive, possessing the form and structure of wood.

"*(d.) Schistose Coal.*—Distinct slaty cleavage, sometimes separating into very thin laminæ.

"*(e.) Earthy Coal.*—Compact, but easily rubbed to powder. Color dull, of various shades of brown."

In all cases the Great Brown Coal Formation of New Zealand is inferior in stratigraphical position to deposits of Argillaceous, Calcareous, and Silicious strata, sometimes assuming the character of "green sands," all of which contain abundance of marine shells and cetacean remains. A certain proportion of the shells are of existing species, but the labours of Dr Hochstetter and Professor Zittell have shown that this formation must be divided into two, if not more, zones, each characterised by marked representative peculiarities of the Marine Fauna.

In some few cases, such as at the Pomahaka river, and at Cromwell, in the Province of Otago, marine shells of a kind that inhabited brackish water (*Ostrea, Melania, Corbula, Cardium*) have been found in alum shales intercalated with the coal seams, thereby proving the formation to have been of an esturine nature.

It was at the close of the great period of depression of the land, ushered in by the gradual submergence of the then existing vegetation to form the Brown Coal seams, and followed by the deposition of the marine strata, that the eruption of most of the doleritic lavas took place, with which commenced the greatest outbursts of volcanic energy that took place during the Tertiary period in New Zealand.

The lower surface of the Brown Coal Formation is everywhere unconformable, resting on all different rocks of greater age indiscriminately. At the line of junction there is generally a layer of clear quartz gravel on a "dirt bed," (soil). The thickness of the overlying marine Tertiary strata and volcanic beds averages 2000 feet. It is rare to find the slightest indication of woody tissue in the Brown Coals of this formation in New Zealand, though the alteration of the carbonaceous matter into the mineral form is far from perfect in many samples. As a circumstance that may probably throw light on the manner in which these deposits were found, it may be mentioned that in the centre seams of the homogeneous coal, and quite isolated from all joints and partings, smooth water-worn quartz pebbles, sometimes of the size of goose eggs, are of frequent occurrence. In some of the Brown Coal seams Retinite (fossil resin) occurs in abundance, but it is often wholly absent from some districts. Besides the marine shells before referred to, the only fossil remains found in this formation are leaves of Dicotyledonous trees and a few ferns.

The second class of Coals which have to be considered, includes all the most valuable varieties that were exhibited, but in the present state of our knowledge great uncertainty prevails respecting their exact geological position.

Not only is the evidence derived from their associated fossil remains very contradictory, but great variety seems to prevail in the quality of the samples from different localities where the beds appear to be truly equivalent. Thus it appears from the statements of Dr. Haast and others that the same fossil plants are associated with the coal from the Buller and Grey as with the Pakawau seams, and yet there is a very marked difference in the quality and composition of the coal from these places; that from the former localities ranking in many respects above the coal from New South Wales, while the latter is only slightly removed in its composition from the class of Brown Coals, the most marked difference being that it possesses the property of caking. This property is, however, wholly wanting in the coal from Shag Point in the Province of Otago, although it is impossible to distinguish the fossil plants associated with it from those occurring along with the Pakawau seams.

On the other hand, the same organic remains that characterize the coal formation of New South Wales are found along with seams of coals at Kowia in Canterbury, and at Waikava in Otago, the quality of which as fuel is much inferior to that of the Buller and Grey.

These anomalous facts may perhaps be to a great extent due to the unequal selection of specimens, some being from well opened and thick seams, while others are mere hand specimens taken from the out-crop; but it is probable that further research will show that in New Zealand we have several coal-bearing formations separated by marine strata, that represent long periods in geological time, but all of which will prove to be of secondary age.

The information which we possess concerning the distribution of these coals and the extent of their workings has been embodied in the Report upon Class I.*

The results of the analyses which follow show that the coal from the Buller and Grey Rivers is as well fitted for steam generating as any that is found in New South Wales, and is quite equal to most samples from Great Britain; while that from the Bay of Islands has peculiar advantages which render it very valuable for the forge.

Perhaps to no class of raw products can chemical examination be applied with more advantage than to coals, nor are there any results which have a more easy and significant application. A knowledge of the chemical constitution of a coal, especially when exhibited in a tabular form so as to be comparable with others, at once enables a correct estimate to be formed of its calorific power, and of its comparative commercial value. In the examination which was made of the various coals submitted for analysis, it was not considered expedient to adopt the somewhat delicate process requisite to determine with accuracy their ultimate composition, as more useful results can be obtained by processes of easier application, and by which the proximate constituents of the coal can be determined with considerable precision. By the ultimate constituents are meant the simple elements of which the coal is composed, such as *Carbon*, *Hydrogen*, *Nitrogen*, *Oxygen*, &c., the determination of which is not, for practical purposes, so useful as that of the proportions of the proximate constituents which arise in the using it for the various purposes to which it is applied. These are the *Fixed Carbon* or *Coke*, the *Ash*, the *Volatile Gaseous matter*, the *Tar*, and the *Water*.

These latter results are at once available to the engineer, the manufacturer of coke, the gas-maker, and the metallurgist, while the former results require certain calculations to render them of service.

The following brief outline of the processes that have been employed will enable the scientific reader to judge of the degree of accuracy which could be attained. In dealing with a substance so variable as coal, from its being a mechanical mixture and not a definite mineral compound, extreme accuracy and constancy cannot be expected in the results, but still they may be sufficiently reliable to afford most useful information for practical purposes.

I. In each case a fair sample of the coal was selected, and finely powdered. The powder thus obtained was then exposed to dry air till it had attained a constant weight.

II. The water was then determined by drying a weighed portion of it in a water bath at 212°, until no further diminution in weight was suffered.

III. A portion was then burnt in a platinum capsule, the resulting residue being the amount of *ash*. The colour of the ash was noted as indicative of the presence in the coal of sulphuret of iron. The quantity and quality of the ash is of great importance to the value of a coal.

IV. A portion of the coal coarsely powdered was heated to a bright red heat in a closed crucible, so as to imitate as far as possible the conditions existing in a gas retort or oven. The carbonaceous substance or coke remaining, after deducting the ash, is entered as *fixed carbon*, its physical properties being also noted as representing the coking properties of the coal. The loss during the process mainly consists of volatile hydro-carbon (such as coal gas, heavy and light oil, &c.) and water, which latter being subtracted, leaves the quantity of volatile hydro-carbon sufficiently near for the purpose.

* Note, page 3 et seq.—ED.

V. The *Sulphur* was determined by igniting a given weight of the coal with certain quantities of Nitrate of Potash, Chloride of Sodium, and Carbonate of Soda, all of which were previously purified from sulphates. The sulphur in the coal would thus be oxydised, and so allow of its estimation in the usual manner, by precipitating it as sulphate of baryta. By this process the whole quantity of the sulphur is ascertained, whether it exist in part as sulphuretted hydrogen, sulphuric acid, or sulphide of iron.

The physical characters of the coal were also noted, such as the structure, hardness, toughness, &c. (these bearing upon their commercial value), as affecting their liability to breakage and production of "small" in cutting or during transit. The specific gravity was also determined.

With regard to the quantity of water in several of these coals when first extracted from the mine, a great part of it is given off when exposed to dry air at the ordinary temperatures, while the remainder requires exposure at 212°. The former may be considered an accidental element, which to a great extent may be escaped by a proper system of working and draining at the mine.

It may be observed here that a great similarity exists between coal (lignite) fresh from the mine and green wood, also between lignite that has been exposed to the air for some time and the same wood "weathered." Their relative proportion of water is about the same for each state, and certain differences are observed in the constitution of both, when subjected to a long exposure to air, which cannot be explained by a loss of water merely. Hence it appears as necessary to season lignites as it does to season wood, in order to derive the greatest advantage from them as fuel.

The very large percentage of sulphur in some of the Brown Coals, when from the almost entire absence of pyrites and sulphates it could not have existed in any ordinary form, is rather a remarkable circumstance, and has been referred to by Dr Percy, in his work upon "Metallurgy."

The results of the following experiments, however, would seem to prove that the sulphur is combined with hydrogen to form sulphuretted hydrogen, which compound is retained in the coal by an absorptive power similar to that which gives to charcoal its properties as a disinfectant.

A portion of lignite rich in sulphur was taken, and exposed to a temperature of 212° Fah.; a strip of paper moistened with solution of acetate of lead was held a little above it. In a short time the paper was rendered quite black, indicating the presence of sulphuretted hydrogen.

A quantity of coarsely powdered lignite was shaken up with a moderately strong solution of sulphuretted hydrogen. In a few minutes all offensive odor was removed, and on testing the solution with the lead paper before described, none of the gas was found to be present; and further, a weak solution of ammonia failed to bring the sulphuretted hydrogen into solution.

Sulphide of ammonia was next tried upon lignite in the same manner; the results were similar to those in the previous experiment.

The same abstraction of sulphuretted hydrogen took place when the lignite had been previously digested in hydrochloric acid at a moderate heat, and then well washed with water. Coal proper was also found to have the same property, but to a less extent.

These few experiments certainly appear to favour the opinion already stated—indicating for coal, and especially for brown coal, the possession of properties no less singular than important.

It was not attempted to ascertain what was the maximum absorption for sulphuretted hydrogen of any particular lignite, but that, even in the most sulphurised of them, the extreme had not been reached was evident from their capacity to retain still further quantities of this gas when placed in contact with it.

The extraordinary quantity of sulphur, often amounting to five tons in a hundred, which exists in some brown coals, without being combined with iron, is, from the above consideration, a circumstance of easy explanation. The deoxydising action of organic deposits on sulphates, especially if soluble, is well known, and such sulphates occur plentifully in the clays and shales that are in immediate contact with the carbonaceous deposits of all geological ages.

These sulphates, on finding their way to any coal bed, would speedily be decomposed by virtue of the property above alluded to; and for a portion of the oxygen thus removed, the coal itself would, most probably, supply the hydrogen necessary to afford us the new compound sulphuretted hydrogen, which gas, as we have seen, is absorbed and retained in the substance of the coal mechanically.

It is only necessary to add that it would be well to keep this absorptive property of lignite in mind, when judging of the value of any sample in which the percentage of sulphur is high, as when in this form and not as a component part of iron pyrites, it will scarcely affect the value of the fuel where a good draught can be had; for the compound sulphuretted hydrogen being easily volatilisable, will, in great part be driven off before it can have injuriously affected the iron work of the stove or furnace in which the combustion of the fuel is effected.

The following Table* has been compiled from the average results of analyses made of the various coals submitted for examination, so that their relative value and peculiar characteristics may be learnt at a glance.

In arranging the coals in this form it has been found that the only order which could be strictly adhered to, and at the same time class the samples according to their merit as fuel, was that founded on the proportion of water combined with the coal as compared with the Fixed Carbon and Volatile Hydro-Carbons, or, in other words, the coal after deducting the water and ash. It is found practically that this relative proportion is, with few exceptions, constant and characteristic of all the specimens of coal examined from any one locality, and that, as it is less liable to vary than the percentage of ash, or of the volatile hydro-carbon alone, it is probably intimately connected, as has been already indicated, with the development of the process by which the vegetation has passed into the mineral form.

The exceptional cases are those of the rare forms of coal which contain deliquescent salts, or where, as in the case of the coal from Kawa-kawa, there is a free acid present, and in such cases it would be necessary that the water combined with either of these be separately ascertained before the coals could be placed in their relative position in the Table.

With reference to the analyses given of the Brown Coals from the Province of Otago, it is only fair to mention that, as a rule, they have been analysed when fresh from the mine, while those from a distance have necessarily to some degree undergone changes by long-continued exposure to the atmosphere. The changes which take place, as previously explained, when alluding to the process of "seasoning" brown coals like wood, though it might injure the massive appearance of the coal, may yet considerably improve the character of its relative composition.

Throughout this Table and the accompanying explanatory notes, the terms

* See end of Appendix A.

employed, though not strictly correct, are used for the sake of brevity. Thus "*Fixed Carbon*" really includes, from the nature of the process, a small and variable amount of gaseous matter (Hydro-carbon), together with a little Oxygen and Nitrogen, and even the entries of water may include traces of Volatile Oils, and in some cases an appreciable amount of Sulphuretted Hydrogen.

No. I. & II.—Common Brown Coal from the Green Island Coal Mines, Situated Six Miles South of Dunedin, Otago.—(*Cat. App. No.* 875, *II.*)

This is a dull, earthy, and very moist coal when first taken from the mine, with a laminated structure and sub-conchoidal fracture. It is traversed by cracks in all directions, and although it has thin streaks of jet passing through it horizontally, it presents no traces of woody structure. The surface is covered with a white powder, probably an efflorescence. It absorbs water readily, with a crackling noise. Its streak is a dull blackish brown; it ignites slowly, and rather smoulders than burns, but yet, when mixed with other coal, especially with the more bituminous coal from Shag Point, it forms a useful fuel. It leaves a very light ash, almost like that of wood, and its coke is slightly metallic.

No. I. is from a different mine. (For full details see p. 111 Otago Geological Survey Report, 1864.)

No. IV.—Jet Coal, from the Clutha Coal Mines, Coal Point, Otago.—(875, *II.*)

This is obtained from the sandstone overlying the 20-foot seam, in which it forms thin streaks. It is bright, lustrous, and compact, and burns only with great difficulty, producing a light red ash. Its coke is iridescent, and unlike that of the other samples from the Clutha mines. Its powder and streak are black.

No. VIII.—Earthy Brown Coal, from Saddle Hill, Twelve Miles from Dunedin, Otago.—(875. *II.*)

This is a portion of the same seam as that worked at Green Island. It is a soft dull brown coal, very moist, with homogeneous structure, and without any trace of vegetable tissue. Its fracture is uneven and rugged, some portions of it being dotted with small white spots. Its powder and streak are of a dark brown color. In burning it gives off a very disagreeable fetid smell. It does not coke, and yields an extremely light ash of a pure white color.

No. II. was a second specimen from the same locality. (See O. G. Survey Report, 113).

Nos. V., VI., & XIV.—Common Brown Coal, Clutha Mines, Coal Point, Otago.—(875, *II.*)

This coal occurs in large quantities, and under the most favourable conditions for working of any yet discovered in the Province of Otago. To the eye there appear to be many varieties of this coal, but chemical examination proves that these differ very slightly in composition. There are five or six seams, dipping very regularly at a low angle, and associated with sandstone, conglomerate, shale, and fine clays, the whole series being clearly displayed in the section afforded by the sea cliffs northward from the Molyneux Bay.

The principal seam is twenty feet thick, resting on a white pipeclay, and roofed by a dull carbonaceous clay shale. The lower part of the seam is very black and compact, and contains the largest percentage of water and ash. Towards the top of the seam it acquires a more laminated character, and the brown amorphous coal alternates with thin seams of jet. No fragments of wood or traces of unaltered tissue can be observed in this coal, but in the shales above, leaves and skins of plants are of frequent occurrence, and perfectly fossilized.

Three analyses were made of this seam, the samples being taken respectively from the top, the middle, and the bottom of the 20-foot seam. These samples were dry and firm to the touch, and appeared of superior quality. The high percentage of water is clearly due to their having been but recently extracted from the mine when the analysis was made.

No. XIV.—SAMPLE FROM TOP OF SEAM.

Possesses a distinct laminated structure, the horizontal surfaces being smooth and shining, while the vertical are dull and ragged. It is dotted throughout with small round specks of a mineral resin, and of which it often contains large nodulated masses. There are crystals of iron pyrites in the cracks. Its specific gravity varies from 1.279 to 1.282.

No. VI.—FROM THE MIDDLE OF SEAM.

It is similar in structure and physical character to the above, but contains more water and ash.

That the sulphur indicated in the analysis in great part is in another form than as a constituent part of either sulphuric acid or iron pyrites is certain, from the result of the following experiments:—A portion of the coal was well powdered and then boiled in a solution of hydrochloric acid, the sulphuric acid then dissolved out would only yield .026 per cent. of sulphur upon the coal. The ash of the same coal gave .89 per cent. of sulphur, and was perfectly white.

No. V.—FROM THE BOTTOM OF SEAM.

Is a much blacker and more massive coal than either of the above. Its fracture is conchoidal in all directions, and it can hardly be said to have a laminated structure. It contains fewer impurities, but nodules of iron pyrites are not unfrequently dispersed throughout its substance. The powder and streak are much lighter in color, approaching a chocolate tint. It possesses more illuminating power than either of the former samples. Its specific gravity is 1.275, which is less than that for the top of the seam, though the quantity, as might have been expected, is greater.

No. VII.—ALSO FROM THE SAME MINES, BUT EXTRACTED AT A LATER DATE.

This specimen has a moderately bright conchoidal fracture, and is traversed by cracks in all directions, and contains laminæ of jet. The freshly fractured surface glistens, but becomes dull on exposure. Its streak and powder are of a dull brown color, and it burns freely with a very slight odour, leaving a light grey ash. (See Otago Geological Survey Report, p. 106.)

No. IX.—BROWN COAL, WAIKATO, AUCKLAND (11), BY WILLIAM ROWE, INSPECTOR OF MINES.

This is a dull black homogeneous, compact coal, containing a few nodules of Retinite. In certain directions, the fracture is conchoidal, while in others, at right angles to the former, it is uneven. Its powder, dull black; coke, unchanged; ash, white; burns freely, and gives a very luminous flame.

No. X.—MATAKANA, AUCKLAND (1), BY THE SUPERINTENDENT OF AUCKLAND.

A very good-looking, compact, homogeneous coal. Its color is dull black along its cleavage, but if broken across, its surface exhibits considerable lustre. It was pulverized with ease, and showed a slight tendency to crack on drying. Its powder is dull black; coke does not cake; ash, red.

No. XI.—MORLEY CREEK, SOUTHLAND (1201), BY G. B. REINECKER.

This block was obtained at a depth of nine feet; the thickness of the seam has

not yet been ascertained. It did not display much disposition to fall to pieces. The coal is jet black, perfectly homogeneous, and it possesses considerable lustre.

When first examined, its water amounted to 18.4 per cent., but prolonged exposure to the air reduced it to that indicated in the analysis. It burns freely to a red ash, without showing the least tendency to cake. Its powder and streak are black, and it yields 56.6 per cent. of brilliant coke.

The exact geological formation of this coal is doubtful.

No. XII.—BROWN COAL. TOTARA CREEK, OAMARU.—(875. *II.*)

This is an inferior looking coal, of a dull brown colour, and having a cleavage somewhat slaty. When first examined it had no less than 25.2 per cent. of water, but by exposing its powder to the air for a few days in the usual manner, 11.8 per cent. of this was found to be accidental, or not properly belonging to it. When dried in this manner it burned freely, with a smoky flame. Powder, dull brown; coke, lustrous; ash, white.

No. XIII.—DULL BROWN COAL, TOKOMAIRIRO, OTAGO.—(875. *II.*)

This has been extensively used, and has been mined the past four years. It is undistinguishable in appearance and physical character from samples of that from the Clutha River and Green Island, having like them, a brown streak and powder. The only discernible difference is, that it yields a semi-metallic coke. Three specimens of this coal were examined, with almost identical results. Its specific gravity ranges from 1.250 to 1.210. (See Otago Geological Survey Report, p. 115.)

No. XVII.

Is another sample taken from one of the large blocks exhibited by Mr T. Reid, from the Tokomairiro Coal Company's Works. (513.)

No. XV.—WAIKATO, AUCKLAND, BY MR. W. ROWE.—(11.)

This was taken from a large block weighing about half a ton, in which the tendency which this kind of coal has to crack and separate into small pieces was well exemplified. It was covered upon most of its surfaces with a white film of earthy matter, which, however, did not appear to raise the quantity of ash to any appreciable amount. Its fracture is semi-conchoidal. Powder, dull black; coke, unchanged; ash, grey.

No. XVI.—LIGNITE, OR WOODY BROWN COAL, WAITAHUNA, OTAGO.—(875. *I.*)

A dull friable lignite, possessing a great deal of woody tissue. It is slightly laminated, burns slowly like turf, with a heavy fetid odour. It contains a great deal of resinous matter in large masses. It leaves an imperfect lustrous coke, has a light buff-coloured ash, and light brown powder. It occurs in a thick bed in the bottom of the Waitahuna Flat, and is perhaps of more recent origin than the brown coal of other parts of the Province. (See Otago Geological Survey Report, p. 116.)

No. XVIII.—BROWN COAL, BIG BEN, CANTERBURY. BY DR. J. v. HAAST, Provincial Geologist.—(469 *a.*)

A black jet-looking coal with conchoidal fracture. It burns freely, with an offensive odour, and is easily pulverised. The powder has a faint tinge of brown; ash, light buff. It yielded 46.9 per cent. of a non-coherent coke, and 4.2 per cent. of sulphur.

No. XIX.—PITCH COAL. SHAG POINT, 30 MILES FROM DUNEDIN, OTAGO.—(875. *III.*)

This, which is the freest burning brown coal in Otago, is probably of Upper Mesozoic age. It corresponds exactly with Dr. Percy's definition of Pitch Coal, and

may be considered to hold the same relative position among the brown coal series that Cannel does to the true or older coals. It is very compact, does not absorb water or soil the fingers. Its colour is a brownish black; fracture, conchoidal and splintery; lustre, fatty, resinous; streak lustrous, and gives a dull brownish black powder. It burns freely, with a rich oily flame, giving off only a slight odour, and leaving a bulky but light argillaceous ash.

Upon distillation it gives off a rich gas at low temperature, and a large yield of gas oils if a low heat be carefully applied. The coke is light and semi-metallic in lustre, and its percentage 50.68, and that of the sulphur 4.78.

This large percentage was arrived at by repeated determinations. Part of it seems to be combined with the gaseous matter in the manner referred to already in the introductory remarks. Specimens of this coal also were exhibited by Mr D. Hutchinson (505), the lessee of the mine, but it was not thought necessary to repeat the analysis. (See Otago Geological Survey Report, p. 115.)

No. XX.—Brown Coal.—Canterbury.

A dull black coal, difficult to ignite; recent fracture bright, cleavage slaty; powder and streak, dull black; ash, light brown. It gave 39.2 per cent. of a non-coherent coke, and 1.6 of sulphur.

No. XXI.—Coal Creek, Mount Somers, Canterbury.

A coal of a dull black colour, fracture uneven, very pyritous, burning with difficulty; powder dull black; ash, white mottled with red. It affords 52.6 per cent. of a non-coherent coke.

No. XXII.—Semi-bituminous Coal, from Waikava, Otago.—(875. *III.*)

This is of Upper Secondary Age, and occurs in seams less than twelve inches in thickness, imbedded in sandstone grits. It is very similar in appearance and composition to that from Preservation Inlet. Colour, jet black; powder and streak, brownish. It is laminated, somewhat fragile, but does not crack on exposure. Many of its cleavage planes show a dull brown colour. Its coke does not cake. Ash white, and, as is frequently the case in these thin seams, its quantity is very large.

Nos. XXIII., XXIV., and XXVI.—Semi-bituminous Coal. Preservation Inlet, Otago.—(875. *III.*)

This is of Upper Secondary age; the samples were procured from very thin and impure seams, and present great irregularities in their composition and external appearance. It is hard, compact, and black, with a splintery cubical fracture, rarely conchoidal. Powder black, with a faint brownish tinge in some samples: streak, black and shining; ash, light buff; coke, unchanged, and does not cake.

Owing to the varieties of character which the samples present, three distinct analyses are given.

No. XXVII.—Bituminous Coal, Kawa-kawa, Bay of Islands. By the Superintendent of Auckland.—(1).

This coal, the geological formation of which is unknown, appeared of superior quality to any of the other Auckland coals. Its color was black, but in part it was covered with brown films; its lustre is resinous; fracture and cleavage very irregular and granular; moderately hard. It burns freely. Powder and streak dark brown and glistening; coke cakes, but does not puff up as do the Nelson and Canterbury bituminous coals. This is a great advantage where a high heat is necessary, as the draught is not likely to be impaired. It is also very porous, but coherent. The ash is light red and easily blown away.

From an inspection of the analysis it will be seen that the amount of water present is rather high for a true coal. The percentage of ash is small, but the sulphur is very high, two determinations giving respectively 5.1 and 4.9 per cent. As only a very small quantity of this can be combined with iron, it will possibly prove no serious objection to the coal. By far the greater portion of the sulphur is in an oxidized state as sulphuric acid, so that it even communicates a sour taste to the coal.

No. XXVIII.—BITUMINOUS COAL. PAKAWAU, NELSON. BY MR. T. W. LEUTHWAITE.—(331).

This is of Upper Secondary age, and is a harder coal than that from the Grey River, but of less brilliant lustre. It burns freely with a smoky flame. Fracture slaty along its cleavage, but across it, conchoidal; powder and streak, black-brown; coke, semi-metallic, caking to a very coherent mass; ash, light buff. Percentage of coke 58·36, and of sulphur, 1·04.

An examination of this coal proved it to be similar in composition to a sample from the same locality previously analysed in the Laboratory of the Otago Geological Survey.

Nos. XXIX., XXX., XXXI., XXXII., XXXIII., XXXIV., XXXV., XXXVI.—AUSTRALIAN COALS.

2401. Morehead and Young, Lambton Colliery, Newcastle, N.S.W.
2402. Newcastle Wallsend Company, N.S.W.
2403. Waratah Coal Company, Newcastle, N.S.W.

Australia furnished several large blocks of excellent coal. Their features were so similar that, had they not been labelled, they might have been thought to have come from the same mine. Their composition also varies as little as their appearance.

These coals are hard and compact, more so than any of the Nelson coals; their color is black, but they pulverize to a black-brown powder. In all the samples two different kinds of coal are present in thin alternating laminæ—one a highly lustrous jet coal, the other dull and not so compact, in part being quite incoherent and rubbing to powder between the fingers. This last does not cake, and burns only very slowly. A sample of it was found to contain 14 per cent. more of *Fixed Carbon* and twice the quantity of ash, that was present in the lustrous compact parts of the same coal.

With the exception of that from Wallsend, iron pyrites in small quantities can be seen disseminated through them. All yield a lustrous and compact coke, swelling up a little, but not so much as in the case of the Nelson coals.

It is not requisite to say anything in praise of these coals, their good qualities having recommended them long since for the use of steam vessels, which is the best certificate of their value that can well be given. By examination of the analysis it will be seen that the only difference in these coals worthy of note is in that sample from Wallsend.

No. XXXVII.—BITUMINOUS COAL, BULLER RIVER, NELSON. BY NELSON PROVINCIAL GOVERNMENT.—(301).

This specimen represented a single seam 9 or 10 feet in thickness.

It is a pitch black, lustrous coal, compact, but easily pulverized; burns freely, with a smoky flame; fracture, splintery; powder and streak, dark dull brown; coke, dull, coherent, puffs up slightly; ash, dark buff, easily blown away.

The percentage of coke is 65.85; that of the sulphur, 1.20.

No. XXXVIII.—BITUMINOUS COAL, GREY RIVER, CANTERBURY—(875. *IV.*)

A very compact coal of Secondary Age, difficult to pulverize. Its color is black, lustre dull—the fresh fracture, however, has a glistening appearance. It possesses a slaty cleavage. Powder of coal, black; ash, light brown. The coal puffs up slightly when heated, and gives 68.37 per cent. of a metallic coke.

No. XXXIX.—BITUMINOUS COAL, GREY RIVER, NELSON—(875. *IV.*)

The beautiful iridescence exhibited by this coal when broken in the direction of its cleavage recommended it for analysis. It appears to be due to the presence of thin films of a white, opaque salt. The cross fracture is black; lustre, resinous; powder and streak, dark brown; coke, dull, puffs up a little, coherent; ash, grey.

The percentage of coke is 64.22.

No. XL.—BITUMINOUS COAL, PAKAWAU, NELSON. BY MR. T. W. LEUTHWAITE.—(331).

This coal, taken from a seam one foot thick, varied greatly in its composition, part of it having a black resinous lustre, and conchoidal fracture, and containing only 5.8 per cent. of ash. But the greater part, and that sample which was analysed, is a very hard, dull, earthy coal; fracture, slaty; powder, dark brown; coke, dull coherent, hard; ash, light grey.

Percentage of coke, 63.2.

No. XLI.—BITUMINOUS COAL, BULLER RIVER, NELSON. BY NELSON GOVERNMENT. —(301).

This coal (exhibited in a set of boxes in the Annex) is singularly free from impurities, and from its external appearance and composition evidently bearing a close relation to the column of coal (37) from the same locality. This sample was not quite so lustrous as some of the Grey River coal, but it had a glistening appearance on certain cleavages. Its fracture is rhombohedral; it easily pulverizes to a brown powder, and yields 58.0 per cent. of a very porous semi-metallic coke. The ash is light buff.

No XLII.—BITUMINOUS COAL. GREY RIVER, NELSON. BY NELSON GOVERNMENT. —(301.)

This also was exhibited in boxes in the Annex of the Exhibition Building. It is a beautifully bright, clear, homogeneous coal. The fracture is generally uneven; in parts, however, plain surfaces are displayed. Its powder is brown, the ash white, and does not appear to have the least tendency to clinker. Ignited it burns freely, evolving a good flame, and when coked in the usual manner it swells up considerably to a porous coherent mass, leaving about 61.20 per cent. of a semi-metallic coke.

No. XLIII.—BITUMINOUS COAL. MALVERN HILLS, CANTERBURY. BY DR. J. V. HAAST.—(469.)

A hard, black, glistening coal, and burns freely with a smoky flame. Fracture uneven; powder, dark brown; streak, brown; ash, white and easily blown away. Coke dull, and puffs up greatly.

No. XLIV.—BITUMINOUS COAL. GREY RIVER, NELSON.—(875. *IV.*)

A coal similar in appearance to No. XXXVIII., but having a greater quantity of ash present. Powder and streak, brown; ash white. It gives a dull looking coke, which puffs up to a very great extent.

No. XLV.—BITUMINOUS COAL, J. E. MANNING, BELLAMBI COAL MINES, NEW SOUTH WALES. BY R. B. MARTIN & CO, DUNEDIN, AGENTS. USED AT THE EXHIBITION BUILDING.

It is a black, moderately hard coal, freer from pyrites and slaty matter than

many of the New South Wales coals, but is mixed with a considerable quantity of "small." Ignited it burns freely, and in a closed crucible gives a semi-metallic, coherent, porous coke, amounting to 74.22 per cent. of the coal. The ash is white.

No. XLVI.—COAL, BULLER RIVER, NELSON.—(875. *IV.*)

A dull black-looking coal, the powder, however, presenting a glistening appearance. It is tolerably hard and compact. The coke is semi-metallic in lustre, very porous and hollow, possessing little coherence; the ash is white. The yield of coke is 67.40 per cent., and its specific gravity from 1.160 to 1.250.

No. XLVII.—BITUMINOUS COAL. BULLER RIVER, NELSON.—(875. *IV.*)

This is a rather friable coal, easily pulverising; its lustre is brilliant, and its powder has a slight shade of brown, though the coal in bulk is black. The fracture is conchoidal. Colour of ash, white. When heated in a closed crucible it puffs up to a hollow ball, and leaves on a continuation of the process 67.84 per cent. of semi-metallic coke.

BUILDING STONES.

The following Report is a modification of that of the Otago Geological Survey, but embracing all the varieties of Building Stone that were exhibited, in addition to those previously examined. The varieties of stones, useful as building material, and which can be obtained in New Zealand, are—

1. Granites, Gneiss, Syenite, Porphyry, and other rocks of the crystalline series.
2. Basaltic and Igneous Rocks.
3. Limestones.
4. Freestones, including all the varieties of Sandstone.

1.—GRANITES, &c.

These are only to be obtained on the Western Coast of the Middle, and in Stewart's Island, where they abound, and might be quarried and shipped with great ease from many of the inlets or *fiords* on the South-West of the Province of Otago.

True Granites, of flesh-color and grey tints, are, however, confined to the South-western extremity of that Province, where they form a great part of the shores of Dusky Bay, Preservation Inlet, Chalky Inlet, as also of Stewart's Island. Gneiss granite, of equally good quality as building stone, is to be found in many other Inlets; and on the North shore of Milford Sound there is one point where there is an immense accumulation of blocks of a grey variety of gneiss, mottled with crystals of garnet, and of all sizes and shapes, lying as if ready for shipment.

Granitic rocks occur in detached areas in the western part of the Provinces of Canterbury and Nelson, but not in accessible positions. Among the crystalline rocks must be classed also the beautiful green Syenite from the North head of Nelson Harbour, and of fragments of which the remarkable Boulder Bank, which protects the harbour, is almost exclusively formed. A dark variety of Syenite is also found on the sea coast in the Bluff Harbour, in the Province of Southland, easily accessible for shipment.

It is unnecessary to say anything in favor of these crystalline rocks as building material. Of all kinds of stone they are well known to be the most indestructible, and it is the great expense of dressing them, on account of their hard, tough texture, which alone warrants the use of any other kind of stone for building purposes of a

permanent character. At some future time it is probable, therefore, that the Sounds of the South-west Coast of the Province of Otago will become famous for quarries, yielding the most durable building material of almost every variety of color that has been noticed among crystalline rocks.

The only exhibits representing this large class of building stone were some polished cubes of the Bluff Syenite, and about 300 hand specimens illustrating the varieties found on the West Coast of Otago.

The following analyses of specimens of Red and Grey Granite are selected from many that have been made in the Laboratory, but most of which are of purely scientific interest :—

RED GRANITE—PASSAGE ISLAND, OTAGO.

Analyses.—Sp. Grav. 2.639.

Silica	68·13	68·48
Alumina, with a little Manganese	12·82	14·65
Protoxide of Iron	6·01	4·77
Lime	1·90	2·06
Magnesia	·10	Trace
Alkalies and loss	10·61	9·59
Water of constitution	·43	·45
	100	100

GREY GRANITE—ANCHOR ISLAND, OTAGO.

Analyses.—Sp. gr. 2·631.

Silica	73·60	74·20
Alumina, with little Manganese	15·80	15·40
Protoxide of Iron	1·20	—
Lime	1·00	·80
Magnesia	·60	—
Water of constitution	·20	—
Alkalies and loss	7·60	—
	100	

Ignited turns buff color.

Many handsome varieties of Porphyry and Hornblendic rocks are associated with the true Granites, and would be valuable for ornamental masonry. These were only represented by hand specimens in the Geological Survey collection.

BASALTIC ROCKS.

The rocks which are commonly known as Basalts or Blue Stones belong to various groups of igneous rocks, such as dolerites, trachy-dolerites, trachytic porphyry, clinkstone, &c. They are of tertiary age, and occur partly underlying and partly overlying the tertiary rocks, interstratified with tuffaceous clays and local beds of altered volcanic ash.

In the North Island, these volcanic rocks are largely developed, and include some of very recent date. True lavas and scorias are of frequent occurrence over a large portion of the Island. In the Middle Island, on the other hand, the igneous rocks appear to be of much earlier date, and to have been nearly all of submarine origin. They are principally confined to the Eastern sea-board, only rarely occurring at a greater distance than forty miles from the coast, excepting as a few narrow

and very local dykes. The greatest development of these igneous rocks is in the neighborhood of the Kai-kora Mountains, Banks' Peninsula, and the hills around Dunedin. In every case they have a distinctly stratified arrangement, and are intersected by dykes of volcanic rocks possessing great variety of composition, showing that their formation must have extended over a long-continued geological epoch.

About thirty of the principal varieties of Basalt have been analysed, and from the results obtained, it appears that the external character of these stones is, for ordinary purposes, a sufficient indication of their durability. Some of the varieties are no doubt very prone to decompose into a ferruginous clay when buried in the soil; but the complex process by which this change is effected, acts so slowly, that provided a sound quality of stone be at first selected, its effect may practically be disregarded, excepting when great durability is required, as in the case of the foundations of large permanent buildings.

The extent to which basaltic rocks are decomposed by acid gives an approximate idea of how far they are likely to be acted upon by the natural solvents contained in the soil; and in order to show the great variety which exists in this respect, the following ten selections from the analyses made are here given.

In Table No. III.,* the composition is only given of that portion of the stone soluble in acid, which is sufficient for practical purposes; but Table No. IV.* gives the results of a few complete analyses that were made of Otago specimens for the information of the scientific reader.

TRACHYTIC PORPHYRY—*Portobello, Otago Harbour.*

No. 1, COMPACT; No. 3, VESICULAR.—These are extremely hard stones, porphyritic from the presence of crystals of glassy felspar (*sanadine*). Their color is nearly white, and their lustre pearly, They are not absorbent of water, nor in the least affected by a solution of Glauber's salt. Though their durability is unquestionable, their excessive hardness will prevent their use for general purposes.

In a state of powder, the specific gravity of No. 1 is 2·469, and in mass 2·259,—a difference caused by the presence of numerous small cavities in the stone.

The specific gravity of No. 3 is 2.533.

No. 2.—QUARTZOSE TRACHYTE.

Exhibited by Messrs. Hall & Co., Governor's Bay, Port Lyttelton, Canterbury. (407.)

Represented by several cubes which were extremely alike in every particular, the base consisting of principally an amorphous and crystallized felspar, the pure white color of which is pleasantly relieved by smoke-colored crystals of quartz.

Their hardness is not equal to that of some trachytes, still it is very great, and must tend to restrict their use to rougher kinds of mason-work. They do not yield in the slightest to the disintegrating effects of Glauber's salt. These stones are said to work much freer at the quarry before being dried.

No. 4.—BUILDING STONES—CANTERBURY.

Similar specimens, numbered on the blocks 1, 4, 5, 9.

The whole of these belong to the group of trachytes, their colors varying through different shades of green. Nos. 5 and 9 are porphyritic. Nos. 1 and 4 are exhibited by Mr. F. Thompson (409); No. 5 by Messrs. Graham & Weybourne (405-6); and No. 9 by Messrs. Chalmers & Hall (402).

Their specific gravities are 2·414, 2·329, 2·402, and 2·357 respectively. The behaviour of these several building stones with strong disintegrating solutions tended

* See end of Appendix A.

to confirm the idea of durability which a physical examination of them would suggest; and the toughness which is a characteristic feature of many of these porphyries especially recommends them for situations where this property is imperatively necessary—in the kerbing of streets, for instance, for which purpose, indeed, No. 9 is at the present time much employed.

No. 5.—NUMBERED ON BLOCKS 3, 2.—CANTERBURY.

These were exhibited by Mr. F. Thompson (409). No. 2 was of a brownish color, mottled with white crystals. No. 3 had a lighter color.

They are both hard, compact stones, but more absorbent of water than any of the preceding ones, exfoliating slightly under the treatment with Glauber's salt, and breaking up with comparative ease after long immersion in water—indeed it is possible they may be worked pretty readily at the quarry before drying; if so, they would prove of more general use than the harder varieties.

No. 6.—SPHEROIDAL CLINKSTONE, BELL HILL, DUNEDIN.

Two large polished slabs and several dressed cubes of this stone were exhibited by the Provincial Government of Otago. It is exceedingly hard and compact; color, a mottled grey, with parallel crossing lines of black.

Its most frequent use is for the foundations of buildings, for which purpose it is eminently suited.

This interesting rock has been termed a clinkstone, only on account of its composition, as its other characters do not agree with the definition of that rock. It is extremely probable that it is a metamorphosed rock from what was originally a bed of tuffaceous sandstone. It now occurs in distinct basaltic columns that decompose into spheroidal masses. Its intimate structure is not crystalline. The black water lines, above referred to, run right through the substance of the rock, irrespective of the superinduced cleavage, and it is difficult to avoid the conclusion that they are the last traces of the original line of deposit.

No. 7.—MOUNT EDEN SCORIA, AUCKLAND. HIS HONOR THE SUPERINTENDENT. (3 AND 4.)

Both of these were exhibited as dressed blocks of stone, No. 4 having been dressed by the Maori prisoners in the stockade. They are alike in every respect—their color a very dark grey. Though exceedingly vesicular and absorbent, they are very hard and coherent, falling but very slightly under the crystallizing action of Glauber's salt.

No. 8.—PENINSULAR QUARRY, ANDERSON'S BAY, OTAGO.

It is a light-colored incoherent stone, easy to work, and occurs in large quantities in very convenient positions, but it is of very inferior quality, rapidly acted upon by a solution of Glauber's salt. It is frequently used, however, where durability is not particularly required.

No. 9.—HALSWELL QUARRIES, CANTERBURY, W. G. BRITTAN, PROP. (401.) NO. ON THE STONE, 7.

It is exceedingly hard and close grained, of a dull leaden grey color; its fracture is semi-conchoidal.

The excessive hardness of this stone will necessarily limit its usefulness.

No. 10.—BASALTIC CONGLOMERATE, PORT CHALMERS DISTRICT COMMITTEE, OTAGO. (516.)

A pedestal was exhibited made of this stone, and also several polished and

dressed blocks. It is most correctly to be described as a *Volcanic breccia*, consisting of a tough greenish paste in which are imbedded fragments, only rarely water-worn, of many kinds of rock, some of which are only known to occur at the surface at great distances from this locality. Among them are fragments of granite, syenite, felstones, porphyry, and other rocks of the crystalline series, that abound only on the West Coast, and which we must assume have been brought to the surface by ejection with volcanic matter. These frequently give rise to irregularities in the dressed surface, but do not affect its usefulness for the purposes to which this stone is principally applied, which are for kerb-stones and foundations of large buildings. It is now extensively quarried close to Port Chalmers, and for many purposes is one of the best stones in use.

It contains distinct traces of gold, and is the same in appearance and composition as the trachytic breccia at Coromandel, which is traversed by quartz lodes.

LIMESTONES.

Twenty varieties of Limestone from different localities in New Zealand were examined, and the results obtained have been arranged in the accompanying Table V.* in the order of their relative purity.

Some of these limestones are suited for the manufacture of quick-lime, and are already largely used for that purpose in the Colony, while others may be advantageously used for building purposes and even as ornamental marbles.

These limestones are procured from formations of widely different geological age; some of them, which are proved by analysis to possess the highest percentage of carbonate of lime, being derived from tertiary strata of considerably modern formation.

Indeed there is a remarkable want of calcareous strata among the older rocks that are found in New Zealand, no equivalents having yet been discovered in this Hemisphere of the enormous deposits of limestone that characterise the Silurian, Devonian, and Carboniferous formations of northern regions.

The principal localities where limestone strata are found may be grouped as follows:—

Among the very ancient formations of gneiss and hornblende schists that prevail along the west coast of the Middle Island there occur crystalline marbles, some of sufficient purity to rank as statuary marbles. Limestones of this kind were exhibited from the provinces of Nelson and Otago.

Compact sub-crystalline limestone, generally of a blue colour and unfossiliferous, so far as yet observed, occurs in extensive masses in the upper member of the mica slate series, specimens being exhibited from Kakanui mountains and part of the Wakatipu lake in Otago, and also from the Dun mountains in the province of Nelson.

Limestone obtained from secondary and tertiary strata were exhibited from nearly every part of the colony, and, as might be expected, showed great variety in composition and degree of usefulness.

They are, with exceptions, of marine origin, and generally highly fossiliferous. Many of them pass into calcareous freestones, and, as a rule, with few exceptions, they are more adapted for use as building material than for the manufacture of quick-lime.

---

* See Table at end of Appendix A.—ED.

No. 1.—LIMESTONE. SOUTHLAND. *(No Cat. number.)*

A large block, appearing perfectly homogeneous in every part; it is crystallized and has only the slightest shade of color. Its structure is jointed, and it is easily broken along the natural divisions.

It is the purest limestone yet analysed here, but is evidently from strata of tertiary age.

No. 2.—LIMESTONE. SOUTHLAND. (1204.) J. HILL, WINTON.

A compact crystallized limestone of considerable purity; its color is a faint yellow, which is most probably due to organic matter, as a sample of lime (No. 1205) said to have been produced from similar stone, was nearly pure white.

No. 3.

Analysis of a hand specimen exhibited in Dr. Haast's collection from Malvern Hills, Canterbury; examined on account of its resemblance to a dolomite or magnesian limestone.

No. 4. FOSSILIFEROUS LIMESTONE. OAMARU. (737.)

This stone is very largely employed by Mr. D. Hutchison for burning into lime.

The quarry is situated at a point where the upper tertiary strata have undergone alteration by the extension of submarine volcanic rocks, probably during the deposition.

The stone used for burning is therefore a product of metamorphism, and does not occur in regular beds, but as dislocated and concretionary masses intermixed with quantities of worthless rock, which greatly increases the expense of extraction.

The rock is generally very compact; its color is light yellow.

No. 5.—LIMESTONE, WAIROA, AUCKLAND. HAND SPECIMEN. *(No Cat. number.)*

A hard, close-grained stone; color, light buff, mottled with black grains.

By the analysis it appears to be a limestone of very good quality.

No. 6.—LITHOGRAPHIC LIMESTONE, OAMARU, OTAGO. (737.)

A very fine smooth-grained stone, hard and compact; its color is yellow, and its fracture is conchoidal.

It has all the external characters of a lithographic limestone, but it does not occur in slabs, being obtained from concretions in the limestone No. 4, which have been more highly altered, and often so intermixed with fragments of volcanic rock as to resemble slag.

No. 7.—TRAVERTINE LIMESTONE, DUNSTAN GORGE, OTAGO. (737.)

Some very fine specimens of this limestone were exhibited. It is exceedingly porous and is colored in parts yellow, more especially on some of its exposed surfaces, which, however, appears to be due entirely to the presence of organic matter, as the lime from the same stone is beautifully white.

No. 8.—LIMESTONE, NELSON, MAITAI RIVER. DUN MOUNTAIN COMPANY. (304.)

A hard, compact, close-grained stone of a bluish grey color; fracture, sub-conchoidal. Occurs in laminated beds between the Serpentine and Maitai slates, on the west flank of Dun Mountain. It can be brought to the Port with great ease by the Dun Mountain railway.

No. 9.—LIMESTONE, AUCKLAND. UNACCOMPANIED BY ANY INFORMATION.

THOMAS BALL, MANGONUI. (9).

A very good limestone, intersected by numerous veins of calc-spar, being hard and compact, and without any well-defined cleavage. The analysis shows it to be pretty pure.

No. 10.—GRANULAR LIMESTONE, OAMARU. (737.)

This is a more compact limestone from the same locality as No. 4, but of a grey color, with a dash of yellow.

No. 11.—LIMESTONE, SOUTHLAND. C. BASSTIAN, APARIMA. (1202.)

This was exhibited as a building stone ready dressed. Its color was fawn yellow. It was rather incoherent and slightly absorbent on its dressed surface.

It exfoliated to a small extent under the treatment with Glauber's salt.

From the ease with which this stone can be worked, it is probable it may be in request for interior work.

There was a good sample of lime shown along with this, obtained from the same kind of stone.

Nos. 12 AND 20.—LIMESTONES. ISLE OF SCINDE, NAPIER. HAWKE'S BAY LOCAL COMMITTEE. (104.)

These were two specimens of fossiliferous limestone from close to the town of Napier.

No. 1 is of a greyish color, tolerably compact and slightly absorbent.

No. 2 is a similar looking stone, but is more compact, and considerably richer in carbonate of lime, as shown by the analysis. When properly burnt, this last should yield a good lime.

Both belong to the upper tertiary series.

No. 13.—LIMESTONE. WAKATIPU LAKE, OTAGO. (737.)

A hard, very compact, grey colored stone of considerable purity. Its occurrence is very opportune in connection with the Moke Creek copper lodes, which are within a few miles of this locality, as limestone affords the flux required for reducing the crude ore to a concentrated and portable "regulus."

Its impurities principally consist of well rounded black grains of silicious sand, along with iron pyrites and traces of bituminous matter.

From the fossils it contains this limestone certainly belongs to the lower tertiary series, but it has undergone considerable alteration, so that it resembles a limestone of a more ancient date.

No. 14.—BLUE LIMESTONE. OTAGO. (737.)

Several blocks of this stone were exhibited by Mr. D. Hutchison, some of which were squared and partly polished.

It is a compact bluish sub-crystalline limestone, the most ancient, and probably the best, of any yet discovered in the Province. It breaks into large rectangular blocks which sometimes appear as if laminated, from the occurrence of narrow parallel stripes of a dark blue color.

Some of the beds are, however, truly fissile, and break into splinters.

The weathered surface is gritty and harsh to the touch; its fracture is angular, and it is traversed by numerous veins of calcspar.

It forms a lenticular mass or stratum several hundred feet in thickness, interstratified with the slates of the Kakanui Range. Its outcrop can be traced in a northwest direction at least five miles.

Wide flat valleys penetrate the limestone range, having a very gentle slope to the Shag Valley Plain, so that quarries could be opened in very accessible positions. It is of a quality that will render it of great value for burning into quick-lime; and brown coal sufficiently good to be used as fuel for this purpose could be obtained hin a few miles.

If this limestone could be quarried in large blocks it would form a highly durable and ornamental building stone, as it possesses all the properties of blue marble, and is susceptible of a high polish.

No. XV.—SHELLY LIMESTONE. SOUTHLAND. *(No Cat. number.)*

This was a large mass of shelly limestone, varying considerably in different parts, but generally possessing sufficient coherence to form good building stone.

The analysis of it renders it very probable that it would be useful for burning into lime.

No. XVI.—GRANULAR LIMESTONE, OR "WHITE FREESTONE." OAMARU DISTRICT COMMITTEE, OAMARU. (517.)

This was furnished in the form of square blocks. The Sun-dial in the corridor of the Exhibition Building was made of the same stone. It is very abundant, and of a beautiful white color.

Some specimens of this stone were found to be very incoherent, and considerably affected by solution of Glauber's salt; others are more compact, but all work freely and harden afterwards. It is decidedly the most useful building stone yet discovered in New Zealand.*

No. XVII.—CONGLOMERITIC LIMESTONE. 3½ MILES SOUTH OF OAMARU. (737.)

A hard, compact, yellowish white stone, resisting considerable pressure. It is rather an impure limestone, and contains traces of soluble salts.

Nos. XVIII. AND XIX.—LIMESTONE. NEAR PORT CHALMERS, OTAGO. PER MR. M'DONALD. (737.)

This occurs in two distinct beds, one of which is dark coloured and the other yellow, which last is overlaid by the former.

The yellow variety contains a rather large amount of fine-grained sand, yellow and black. A portion of it when burned, however, slowly fell on moistening it with water, and its color was changed to a much whiter hue than before.

This valuable limestone occurs on the Otago Peninsula. It has not yet been discovered in a convenient locality for shipment, but it probably will be.

Two other samples lately received, a dark and a brown variety, gave to a partial analysis about 14.20 and 18.20 per cent. of insoluble matters respectively, and they readily burn to pretty good quick-lime. It thus appears that Dunedin and the surrounding country will probably be yet supplied with a very useful limestone within very short distances—a boon very difficult to over-rate.

FREESTONES.

Freestones in all countries where they can be procured, form the most desirable building material, on account of the facility with which they can be dressed. The samples exhibited are principally from among the tertiary strata, and although they are used to a considerable extent as building material, they are generally adopted with distrust, owing to their apparent want of durability. Chemical examination, however, proves, that many of the varieties can be safely recommended as quite equal

* This stone can be sawn and moulded by machinery as easily as wood. Nearly the whole of the mouldings of the New Post Office, Dunedin, are being so worked. Moulded capitals, which would each occupy an experienced mason six hours, have been worked in as many minutes, and better and cleaner than could possibly be done by hand. Twenty-two cubic feet weigh one ton. Moulded pillars of this stone let into the ground round a grave in a local cemetery, have been exposed to all weathers for the past eight or nine years without injury.—ED.

to freestones which are in use in England, provided proper care be taken in their selection, and that therefore this distrust is not always well founded. On the other hand, several of the varieties which have a most promising external appearance are found to have a minute percentage of elements that will be certain to cause rapid decay when exposed to the influence of the weather. The stones chosen for examination by chemical analysis have been therefore such as present variety of character sufficient to indicate the principle upon which their selection as building materials should be made, and it is believed that all varieties are embraced in the classes into which the specimens analysed have been divided.

In making a scientific examination of a freestone or mechanically formed building stone, we have to regard its physical and chemical properties.

The latter are of very great importance, as by a knowledge of the constituent minerals of a rock, we arrive at a fair estimate of its power of resisting the various destructive chemical influences to which it will be subjected.

Chemical analysis in many cases affords the only means by which we can discover that a stone of most promising appearance, judging by the external characters, contains elements that will lead to a speedy decomposition, as frequently the stability of the material is seriously affected by the presence of some accidental impurity existing only in very small quantity. Thus experience has clearly shown that it is the presence of minute proportions of alkaline salts in the stone used for exterior masonry which has caused the disfiguration of some of the finest edifices in Great Britain.

It is, therefore, particularly necessary to ascertain the impurities which are contained in freestones, by which are meant the elements that do not form an essential part of the stone, but the detection of which is generally of more importance than the determination of the principal constituent minerals.

In making the various analyses hereinafter given, especial attention has been directed to this subject, and in the Table appended, the presence, nature, and amount of these impurities have been indicated in separate columns.

On the other hand, the durability and value of building stones depend almost to an equal degree on their physical properties, as on those above alluded to. Their hardness and tendency to absorb water; their structure, whether massive or laminated; the facility with which they can be broken into masses of convenient size and shape, or worked with the chisel with plain or curved surfaces; their power of resisting the effects of frost; the drying and baking action of the sun—all these are points which can only be imperfectly ascertained in the laboratory, and require for their determination the opinion of the practical architect, founded on the experience which time alone can furnish.

As a means of increasing the useful application of Freestones, it may be suggested that by the method of artificially hardening the surfaces of stones, which has been patented by Ransome, of Ipswich, we have a means of rendering durable, at a very small expense, even inferior varieties of freestones.

An experiment was made in the laboratory on a small scale, with a cube of the ordinary yellow Caversham stone, with a very successful result. Ransome's process consists in first washing the stone with soluble glass or silicate of potash. After this has entered into the grain of the stone, it is decomposed by a solution of a salt of lime, the acid of which seizes the potash, an insoluble silicate of lime being simultaneously formed, which, acting the part of a cement, binds the particles of the stone firmly together. In the experiment that was made it was found that the stone contained a sufficient quantity of the requisite salt of lime, so that upon the applica-

tion of the water glass alone, the cementing and hardening processes were found to have penetrated the surface of the stone to the depth of one-sixth of an inch, which would be amply sufficient to resist the influence of weather.

Freestones are naturally divided into three groups, according to the nature of the cement that binds their particles together.

A.—Silicious Sandstone, or Freestone proper, containing particles of silicious sand, cohering by a silicious, ferruginous, or argillaceous cement. A perfect stone of this class—that is, possessing the requisite tenacity and freedom from impurities, is the most useful building stone we can have, as it unites great durability with the property of being easily worked into any desirable form.

B.—Argillaceous sandstones, or clay-stones. The gradation from the last class to this is represented in every stage, as the silicious matter becomes deficient and is replaced by clay as a cementing material. The stones belonging to this group can rarely be depended on for durability.

C.—Calcareous sandstones. In this class of freestones the particles or grains of the above are partly silicious, but the cementing matter consists of carbonate of lime, derived from marine shells. These stones vary much, according to the proportion of calcareous matter present, and the extent to which it has combined with the sandy matter, or been dissolved from the fragments of shells and re-deposited as a true cement. The great objection to the use of these stones arises from the circumstances that, if uniform in texture, they are soft and destructible, while if hard, their consolidation has been generally owing to concretionary forces that never fail to produce great irregularities in the quality of the stone.

Many calcareous sandstones harden upon exposure to the atmosphere, but generally on the surface, so that a crust is formed that peels off on the first attack of frost.

Table VI.* (taken from the Reports of the Government Survey of Otago, 1864, p. 125), gives the variety of composition of thirteen samples of stone that indicate the above classification.

The true Silicious Freestones are found at the base of the tertiary and in the upper secondary formations, where they are associated with beds of coal. Among the schists there are, however, arenaceous beds in which the cleavage and jointing characteristic of metamorphic strata has been only feebly developed. These freestones might be included among the most valuable building materials of this class. Such are to be found in nearly every part of the central district of the Middle Island.

Of the silicious freestones the principal development in the Province of Otago is in the Horse Range, and where those hills abut on the coast at Shag Point there are beds of excellent quality exposed, which apparently are continued into the interior, underlying the great conglomerate formation of which the broken ground along the east flank of the Kakanui Mountains is composed.

To the south of the Molyneux River there is another great development of this formation, associated with more ancient strata of undetermined geological age. The stone mentioned as from Waikava belongs to this series of rocks, and is said to be associated with a good quality of coal, but only as yet discovered in thin seams, and convenient for shipment from the excellent harbour at that place.

In Preservation Inlet, on the south-west coast, there is a third extension of silicious strata in an accessible position for shipment, and probably of more ancient date

* See end of Appendix A.

than those associated with the coal on the east coast. In this locality, and especially on Coal Island in the first mentioned Inlet, many of the beds have the character of flagstones, and might be useful as paving material. Moreover, the strata there rest on Clay Slates that present more perfect cleavage than any met with in other parts of the Province, excepting in the valleys of the Matukituki and Dart rivers; and if these strata were examined with care for that purpose, it is very probable that places would be found where quarries might be opened for the extraction of valuable roofing slate.

The Argillaceous and Calcareous Sandstones are, without exception, confined to the upper tertiary rocks. Their variable and concretionary character has already been alluded to, but there undoubtedly exist large deposits which will afford most valuable building stone. The valley of the Wairau, the neighbourhood of Dunedin, Waikava, and Oamaru, yield many varieties of stone, but none of them can be expected to present great differences in composition from the specimens of which the annexed analyses have been made.

As yet we possess very imperfect information respecting the quantity and quality of the freestones, either quarried or suitable for building purposes in the other Provinces of New Zealand, but as the formations above alluded to are distributed throughout every part of the Colony, all the varieties indicated in the following sample analysis will doubtless be met with.

The following table, No. VII.,* gives the results of the analyses of the specimens that were placed in the Exhibition from various parts of New Zealand.

Nos. 1 and 5.—Tasmanian Freestone. (2301 *to* 7.)

Several samples of building stone were exhibited from Tasmania, but they were so imperfectly labelled that, in most cases, it was found impossible to connect the specimens with the description given in the Catalogue. They were all so similar in composition that the two analyses given may be taken as the average for all.

The stone examined is considered of very superior quality by builders. Its base is eminently silicious, being a coarse sandstone composed of grains of quartz, cemented by a very small proportion of foreign matter.

It contains, however, a certain amount of soluble and deliquescent salts, that prevents its being classed with the most durable stones. Neither moisture nor the sulphate of soda test, however, affect it to an appreciable extent.

The most marked difference between the two samples examined is in the smaller percentage of soluble salts contained in No. 1.

In connection with the building stones from the Colony of Tasmania, and exhibited under the above Catalogue Nos, there is a beautiful block of "black and white Marble" from Chudleigh, per Mr. G. Whiting, of Hobart Town, one face of which was polished. It is said to occur in large masses, is easily accessible, and makes good lime.

A specimen of Grey Granite, obtainable in any quantity along the coast at Port Seymour, was forwarded by Mr. O. H. Hedberg, one side of which was polished. It is sometimes found in very large blocks.

No. 2.—Arden Bay, Otago Harbour. (737).

A very smooth-grained sandstone, white on the fresh fracture, but acquiring a warm tint on exposure to the atmosphere. It is composed of very fine grained white sand, and the greatest part of the cementing matter appears also to be silicious. It absorbs water only to a moderate extent, and does not crumble much more easily

* See end of Appendix A.

when moist than when dry. The surface became only slightly affected under the sulphate of soda test.

If this stone can be quarried in large quantities, uniform in quality with the sample, it will be a valuable building material, although from the large quantity of impalpable cementing matter it contains, it will not be durable if much exposed to the weather.

No. 3.—QUARTZOSE SANDSTONE, GOVERNOR'S BAY, LYTTELTON, CANTERBURY. GRAHAM AND WEYBOURNE. (405.)

This appears to consist of a coarse-grained quartz sand, mixed with a little mica, and bound firmly together with a silicious and ferruginous cement. Its color is a faint yellow, mottled with red grains. Though very hard and coherent, it is slightly absorbent; solution of sulphate of soda, however, failed to detach more than a few grains in three days. It bears a great resemblance to a stone exported from Hobart Town in large quantities for decorating purposes.

No. 4.—BUILDING STONE FROM NEAR MOERAKI. (737).

This stone is of a light grey color, and contains numerous small flakes and specks of carbonaceous matter.

Although at first sight it appears to be superior to most others in the Province of Otago, especially if judged by the dressed face, it is really of very inferior quality, as it absorbs water rapidly and falls to sand.

It, moreover, contains a large amount of deliquescent salts, which must attract moisture from the atmosphere, and assist the process of disintegration.

Upon lævigation it gave—Clay 44, Sand 56,=100.

It rapidly exfoliated when submitted to the sulphate of soda test, and crumbled to sand in a few days.

No. 6.—BUILDING STONE FROM MOERAKI, (TROTTER'S CREEK.) (737.)

This is a loose and coarse-grained silicious sandstone, very absorbent in water on the undressed surface. Its color is a rusty red.

It contains a considerable quantity of broken and rounded pieces of quartz, with a little mica, but from the salts of iron which it contains being so easily decomposed on exposure, it is a very inferior building stone.

No. 7.—BAY OF ISLANDS FREESTONE. AUCKLAND. (1.) HIS HONOR THE SUPERINTENDENT.

This was exhibited in the form of a smooth-faced block, its color was white, mottled with dark grains; though slightly porous, it was very hard.

If this stone can be economically worked it will prove very valuable for the erection of permanent buildings.

No. 8.—BUILDING STONE. SADDLE HILL. (737.)

This is similar to that from Arden Bay (No. 2) in appearance, excepting that it is slightly vitrified, as if from the neighbourhood of an igneous dyke.

It is harsh, but not gritty to the touch, rather absorbent, and, upon lævigation gave—Impalpable cementing matter 44, Sandy residue 56,=100.

When treated with sulphate of soda it did not yield or crack, although an efflorescence formed on its surface, indicating that notwithstanding its *coherence*, it was still porous to a certain extent.

No. 9—GREYISH GREEN QUARTZOSE SANDSTONE, FROM WAIKAVA, S.E. DISTRICT. (737.)

This sandstone, which is very similar to some beds associated with the older

brown coal formation in other parts of the Province, is composed of angular grains of transparent quartz, fragments of felspar, and flakes of mica, cemented by a little clay and carbonates of lime and magnesia.

It has a disagreeable color, but in texture and stability is superior to any of the sandstones in the Province which have as yet been examined, although others have been seen that will probably prove of quite as good quality. It absorbs water to a slight degree only. When crushed to a coarse powder, and carefully lævigated till the water ceases to be turbid, it yields—Sandy matters 84.5, Clay and cementing matters 15.5. Treated with sulphate of soda it exfoliated only slightly on the undressed surface.

The locality from which this stone is procured is said to be favourable for shipment from the harbour of Waikava, where a quarry could be opened in a position accessible to vessels drawing ten feet of water. The strata belong to the secondary coal series, but the coal as yet discovered only occurs in thin and unimportant seams.

No. 10.—MOUNT PLEASANT, ANDERSON'S BAY. (737.)

This is a smooth grained tufa-stone, or consolidated mud mixed with sand and fragments of various rocks.

Although less porous and absorbent than many other stones, it breaks up rapidly when tested with sulphate of soda, so that it will not resist the action of frost. It contains a small quantity of magnetic iron sand.

No. 11.—BUILDING STONE, VICINITY OF DUNEDIN. HUGH CALDER, CAVERSHAM. (1063.)

This is a very hard compact stone, having the character of an impure concretionary limestone. From the specimen submitted, which is like a portion of a flagstone, no judgment can be formed of its usefulness as a building material, but from its evident concretionary structure it can hardly be expected to occur in large quantities.

No. 12.—CALCAREOUS SANDSTONE, CANTERBURY.—(NUMBERED 404, AND XXXII ON STONE.) (404.)

No. 404 is furnished by Messrs. Forgan and Son, from the Weka Pass, where it exists in unlimited quantity. No. XXXII. is from the same Range.

Though affected by solution of salts, their durability, if properly faced, need not be feared.

They are said to harden upon exposure, and to work very easily.

No. 13.—CALCAREOUS SANDSTONE, OYSTER POINT, UPPER HARBOR WEST, OTAGO. HUGH CALDER, CAVERSHAM. (1063).

A very hard dark grey stone, possessing considerable cohesion. It is similar in physical appearance and composition to that furnished by Mr. Hugh Calder from the vicinity of Dunedin. It is seen to advantage when the tide is down, as it forms a level floor at a small angle to the horizon, running below high water mark. It also forms the under part of a cliff, but there it is not quite so hard.

No. 14.—IMPURE SILICIOUS LIMESTONE, FROM PLEASANT RIVER, SIX MILES FROM WAIKOUAITI. PER MR. W. MASON. (737 *Appendix.*)

This stone, which it was proposed to use in the erection of the new Post Office in Dunedin, has a very close, uniform texture, and is well fitted for the execution of ornamental carvings. It is obtained from the tertiary strata that underlie the basaltic rocks of Pakatapo, and is of the same geological age as the Caversham and Oamaru sandstones.

Its composition proves it to have more the character of a very impure chalky stone than of a freestone proper, and although it is without traces of oolitic or granular structure, there is no doubt that it has been originally an impure calcareous mud, the consolidation of which has been due to internal chemical action. Being therefore of concretionary origin, it will probably be liable to irregularities in quality, so that very careful supervision of the stone as it is extracted from the quarry will be necessary to insure uniformity.

Tested in the usual manner it is found to be very slightly porous, and to resist the action of salt.

On the whole, it must be considered the best quality of tertiary stone that has been examined. For public buildings, however, it will be perhaps advisable to use the blue limestone (No. 1) of the Kakanui Range, in the external work, provided a quarry is found from which blocks of sufficient size and free from flaws can be procured. The locality is only a few miles more distant from the shipping port, a disadvantage which is more than compensated for by the marked superiority in the quality of the stone.

For ornamental carvings, however, that will not be exposed to the weather, no stone would be more suitable than the above-mentioned from Pleasant River.

No. 15.—CALCAREOUS FREESTONE, CORNISH MOUNT, WAIKOUAITI. WAIKOUAITI DISTRICT COMMITTEE. (515).

This stone was furnished by Mr. J. Hepburn. Although of a darker color than the stone from Mount Pleasant in the same neighborhood, no material difference could be detected between the two, either physically or chemically. Both equally recommend themselves to the attention of the architect and builder, as stones easy to work, but sufficiently coherent and durable to admit of their use for a great variety of purposes.

No. 16.—CALCAREOUS SANDSTONE, WAIHEMO. (737).

This is a light-colored and very incoherent stone, falling rapidly when treated with Glauber's salt, but hardening a little upon exposure to the atmosphere. It was exhibited in roughly-squared blocks furnished by Mr. Lake to the Otago Geological Survey Department.

No. 17.—FREESTONE FROM KAIKORAI VALLEY. (737).

This sample was taken from the bed of the stream, about a quarter of a mile below the old limekiln quarry, on account of its having apparently resisted the action of the water.

It has a finer grain and more compact texture, and contains a much smaller quantity of clay matter than is usual in the Caversham sandstones.

It is impossible to say until workings are commenced whether this stone can be procured in large quantities, as it is extremely variable in its composition within short distances, but this specimen is certainly much superior to any of the other stones examined from the Caversham group of strata. It is very slightly porous, and withstood the sulphate of soda test.

No. 18.—SANDSTONE FROM SIBBALD'S QUARRY, CAVERSHAM VALLEY. (737).

This, like No. 13, is really an impure limestone; the impurity being quartz sand, with a little mica and clay.

From the comparison of the analytical results appended, it will be observed that the greater part of the lime must exist as calcareous sand, apparently fragments of shells.

This is unfortunate, as, if it had been dissolved and re-deposited as a calcareous

infiltration or cement, a durable building stone would have resulted. There is no doubt the induration will proceed more actively when the stone is exposed to the air; but its particles have so little cohesion, that the weather, and especially the frost, will affect it more rapidly than the hardening process. When exposed to the crystallising force of sulphate of soda, its surface was much affected, but it rather threw off flakes than fell to sand. It absorbs water to a moderate extent, and when moist is very friable.

In the quarry it presents no decided bedding or jointings, but being soft, is very easily worked. There are two varieties, the lower one just described being of a greenish grey color, whilst the upper variety is of a buff color. No line of stratification appears to divide them, and the principal difference in composition lies in the quantity of fine yellow clay which the light-colored sample contains, which of course renders it of inferior value to the grey.

No. 19.—BUILDING STONE, FROM HAWKSBURY. (737.)

This is a calcareous sandstone similar to that obtained from Kaikorai and Caversham, and not only are its essential constituents the same, but they bear about the same proportion to each other. When properly faced it appears almost impervious to water, but otherwise it gradually loses its coherence.

It has the disadvantage of containing appreciable quantities of lime and soda in a form which renders them soluble in water. It is still, however, superior to either of the above. It contains a considerable quantity of magnetic black sand, and, among the insoluble matter, it contains mica.

No. 20.—CALCAREOUS SANDSTONE, TOKOMAIRIRO. (737.)

This has much the appearance of a compact basalt; it is very coherent, close grained, moderately hard, and has a bluish grey colour. It was not affected in the least when subjected to the action of Glauber's salt. At present it is only used as road metal; in parts it is fossiliferous.

The part mentioned in the analysis as insoluble in acids, appears to be principally composed of rounded grains of quartz and olivine.

No. 21.—BUILDING STONE, KAIKORAI QUARRY. (737.)

This stone is similar in appearance to the upper beds of the Caversham sandstone, and contains a large percentage of an impalpable clay of a yellow color.

No. 22.—CALCAREOUS SANDSTONE, AUCKLAND. HIS HONOR THE SUPERINTENDENT. (1.)

This was a hard and very compact stone: color, mottled black and red.

It was but very slightly absorbent, and was not seriously affected by solution of Glauber's salt, a point of no importance in the province of Auckland, where it would not be subjected to frost. It should prove a durable and valuable stone for building purposes.

No. 23.—FREESTONE. MOTUPIPI, AUCKLAND. HIS HONOR THE SUPERINTENDENT. (2.)

A moderately hard green-coloured stone, with black particles interspersed through its mass. Though but slightly absorbent on its dressed surface, it was considerably affected by Glauber's salt; on the second day after the application it could be easily broken between the fingers in any direction. For situations, however, where it would not be much exposed to violent wind and rain, it might prove a valuable building stone.

No. 24.—CALCAREOUS FREESTONE, MOERAKI. PER F. D. RICH, ESQ. (737.)*

A rough block of mottled white and red freestone, in composition partaking of the nature of a calcareous freestone, but being very porous and absorbent of water, it is easily pulverised and disintegrated by frost.

GOLD.

The principal subject in connection with this metal which requires the attention of the analyst is the nature and proportion of other metals with which it is always to some degree alloyed, and which causes it to vary in its intrinsic value without visibly affecting its external appearance.

Only, however, in the case of gold from one locality in New Zealand was the amount of alloy found to be so large as to require particular reference to it.

This was the gold from Coromandel, in the Province of Auckland, the color of which is of an unusually light tint.

Two samples of this gold were analysed, and were found to contain 24·50 and 45·00 per cent of silver respectively.

Other specimens of gold, exhibited also from Auckland, appeared to be of the usual purity of that from the southern part of the Colony, which is alloyed only with a small portion of silver and copper.

The gold found in Otago varies from 23c. to 22c. 2gr., or in other words contains from 95·98 to 92·57 of pure gold, and therefore varies in value from 3s. 4d. to 2s. 3d. per ounce above standard coined gold, which is valued at 77s. 9d. per ounce.

The remarkable variety of lustre and color which exists in the gold from various parts of Otago is due not to any marked difference in the purity of the gold, but rather to the individual particles being coated with a thin film of sesqui-oxide of iron, which is often sufficiently thick to impart to the gold dust as dark a shade as linseed.

In connection with this metal several examinations have been made of the mundic tailings from quartz crushing machines. The mundic occurs along with the gold in the reef quartz and neighbouring rock, and always contains a certain percentage of gold that resists the ordinary processes adopted for the separation of the precious metal.

The result showed that the loss of gold from the quantity of mundic thrown away is very considerable, as the mundic or iron-pyrites is exceedingly abundant in some quartz reefs, and when crushed is always rejected with the ordinary sandy tailings.

Assay of Tailings, &c.

Arsenical Pyrites in the form of fine dust from the Waipori reef in Otago was first examined. It had previously been passed through an amalgamating machine, and all the gold had been taken from it which the most careful management could effect by this means.

It was first gently roasted to get rid of the arsenic and sulphur, and traces of mercury were volatilized during this operation which had no doubt been left from the mercury used at the reef.

After this was effectually performed the ore was treated with warm hydrochloric acid and digested until the residue was of a yellow color. The application of mercury easily then effected the separation of the gold from the insignificant amount of quartz and scheelite left, and the weight of gold in the amalgam afterwards ascertained.

* 737, Otago Geological Survey.

In this case there was found no less than at the rate of 8 ozs., 17 dwts. to a ton of tailings, although the presence of gold could not be detected by the eye; every ton therefore of this would contain gold to the value of about £33, which makes it not at all improbable that, when acids are cheaper, these tailings may be profitably worked by some such system as that above described. A previous roasting of the ore at the mine before amalgamation might increase the profits of working it very considerably.

Tailings from Coromandel.

Some mundic tailings from No. 5 claim, Coromandel, the workings of Mr. James Ninis, were also qualitatively analysed for gold.

The mundic is disseminated largely not only through the reefs at Coromandel, but also in the matrix of the rocks.

Treated according to the system previously indicated, they yielded to two analyses respectively 32 and 37·35 ozs. of gold to the ton of ore, associated, however, with a rather large percentage of silver, which, as before observed, appears to be a characteristic feature of the Coromandel gold.

In California it has been found that when sand tailings from quartz mills have been lying in a moist state, although they contain no appreciable quantity of gold at first, in a few years it is possible to extract gold from this by washing with a pan or cradle, a circumstance frequently taken advantage of by the Chinese.

PLATINUM.

The Province of Nelson has forwarded at different times several specimens of Platinum and one of Osmium-iridium. The former occurs in small flat grains of a steel gray or silver white color, and the latter in much the same form, but it is of a brighter color and is less malleable.

As platinum is a metal easily overlooked in searching for the more valuable though scarcely more useful metal, gold, it may not be amiss to mention here how the gold digger with the rude appliances at his command may readily identify this metal, or at least establish the claim or otherwise of any substance he may have found to be named among those rare metals belonging to the same class.

After ascertaining the suspected substance to be a metal of this class by the test of malleability or high specific gravity, the only metals which are at all likely to be mistaken for these rare metals are iron and lead, and it is only necessary to ensure that it is not these in order to be certain that the metal examined is valuable. If it is iron it will be *powerfully* affected by the magnet, and if lead easily melted in a common fire. These tests are conclusive.

All these rare metals are more or less malleable,—platinum readily so; and they vary in specific gravity from 10. to about 20., water being 1.

SILVER.

Silver in a native state was exhibited in small rolled fragments in the Otago Gold Fields Department, from the Wakatipu Lake Diggings. One sample examined would be properly called antimonial silver, from the presence of a large quantity of antimony.

Silver in grains was also exhibited by Mr. T. W. Tatton (307), in the Nelson Department, probably obtained from Galena, but this was not stated.

MERCURY.

Mercury, united with gold to form amalgam, and also with sulphur as cinnabar, was received from Waipori, where both occur in the auriferous alluvial deposits. Sometimes only one end of a particle of gold is coated with mercury, giving a singular appearance. The cinnabar is in roundish pieces of various sizes, sometimes as large as peas, soft, and occasionally almost pure, indeed the ease with which this ore is broken up forbids the idea that it has been transported from any great distance. Cinnabar is the principal ore of mercury, the many important uses of which are well known. It is found on several of the Otago gold fields, and rolled fragments are sometimes found imbedded in the older tertiary quartz cement.

LEAD.

Lead in the shape of bars was exhibited by Mr. T. W. Tatton (307), in the Nelson Department. It appeared to be sufficiently pure for all ordinary purposes.

As sulphide of lead or galena, this metal was pretty generally exhibited through the various departments, but with the exception of a well formed crystal from the Otago Gold fields it was much mixed with quartz.

As would be expected, silver has been found associated with all the galena yet examined, also antimony with some. Galena has also been found in the vicinity of the West Taieri in the Province of Otago.

ANTIMONY.

Antimony, united with sulphur to form Stibnite, has frequently been forwarded to the Laboratory for identification. Some specimens so received have been remarkably rich in antimony. These were placed in case No. 701-M2. As yet it has not been found associated with any other mineral but quartz. Very fine specimens of this kind were exhibited by the Wakatipu Lake Committee, and in the Geological Museum, having been obtained from a reef in the Shotover district. It is also found in the neighbourhood of Waipori.

COPPER ORES.

There were several ores of this important metal exhibited, but it was only thought necessary to examine those from ascertained localities. They will be treated of in an order corresponding to their richness.

MALACHITE WITH CUPRITE.—TOKOMAIRIRO, OTAGO.

This was said to have been found in the neighbourhood of Tokomairiro. It is a mixed ore, but essentially consisting of oxide and carbonate of copper, the latter coating it externally.

By the analysis it will be seen that there are only traces of sulphur present, in which it shows a similarity to the ore from the Burra Burra mine in South Australia. Unfortunately this ore has not yet been discovered *in situ*.

Analysis.

Copper	58·20
Iron	1·10
Silica	3·33
Sulphur	traces
Carbonic acid and water	37·37
	100·

RED COPPER ORE, OR CUPRITE.—NELSON.

There were several fine specimens of this variety of ore, in which the oxide is mixed with silicious matters, the partings being generally coated with a silicate and carbonate of the same metal. Only traces of sulphur were present in the ore. That piece labelled D.M.49 gave 35·60 per cent. of copper.

This ore occurs in serpentine and other magnesian rocks in small surface veins and associated with native copper of absolute purity, as also with an ore which is an intimate admixture of the oxides of copper and iron, samples of each of which were exhibited with those of the adjacent rock.

COPPER PYRITES.—WANGPURAPURA, AUCKLAND.

This is associated with quartz; its color is a rich bronze, but in parts it has a beautiful play of colors. A fair sample of the ore and matrix together yielded 30 per cent. of copper.

COPPER PYRITES.—OTEA. (5.)

This ore has been worked to a considerable extent: it was furnished by the Otea Copper Mining Company.

If its value were judged of by its color, it would be pronounced of very inferior quality, but a partial analysis showed how deceptive the appearances of these ores often are, as it yielded 24 per cent. of copper.

The mine whence this ore was obtained has been worked to a very considerable extent by a local Company, and has produced ore to the value of about £30,000 sterling. It is now being worked by an English Company, who have commenced by erecting efficient machinery for separating the ore from the matrix. It is to be remarked that this mine, which has yielded so large a return, produces only pyritous or sulphide ores, which it is well known occur in greater abundance than any of the other ores of copper.

The lodes containing this pyritous ore show also a greater regularity, and are consequently more to be depended on, than lodes containing native copper or its oxides. In Cornwall, pyritous ore, mixed with an excess of iron pyrites, is almost the only variety of copper ore raised, and to this may be attributed the steadiness of the supply from these extensive mines.

COPPER PYRITES.—BARRIER ISLAND, AUCKLAND.

This ore occurs in a matrix of quartz, and has a rich brass color. A fair sample of the mixed specimen afforded 26·52 per cent. of copper. Exhibited in the Geology Survey Museum of Otago.

COPPER PYRITES.—MOKE CREEK, OTAGO.

This is essentially a double sulphide of copper and iron; its color is pale yellow on a fresh fracture, but it acquires a deeper tint upon exposure.

From a great number of specimens of this ore which have been forwarded to the Laboratory at different times and analysed, it has been ascertained that the percentage of copper in this ore varies from 11 to 25 per cent. In the Cornish copper mines this ore is frequently worked when it only yields 4 per cent. of copper, the average of the sales for the last quarter showing an average produce of but 6 per cent. The following are analyses of two different specimens of this ore:—

	I.	II.
Copper	11.57	25.60
Iron	46.50	41.40
Sulphur	40.44	31.60
Silica	1.49	1.40
	100.	100.

A further analysis of No. II. gave 24 per cent. of copper, as indicated by the color test. Another specimen of this ore, presented to the Geological Survey by Vincent Pyke, Esq., afforded 24.30 per cent. of copper.

A rich copper ore, also of the pyritous class was presented by J. Vogel, Esq., from this locality. It contained 24 per cent. of copper.

COPPER PYRITES.—WAIPORI, OTAGO.

This ore was presented by J. Vogel, Esq. It has a very compact amorphous form, and is permeated by small fissures, the sides of which have a reddish color, the rest of the ore being of a pale yellow. The specimen itself was almost entirely free from quartz. Its percentage of copper was 14., the rest would be iron and sulphur. Another sample from the same locality gave the following results when analysed :—

Copper	15.03
Iron	28·00
Quartz	21.00
Sulphur	35.97
	100.

A more recent sample was found to contain 15.70 per cent. of copper. These ores have the same general appearance and character as that from Moke Creek.

COPPER PYRITES IN QUARTZ.—COROMANDEL, AUCKLAND.

This was a quartziferous ore of copper. After deducting 25·52 per cent. of quartz, the pyrites afforded only 6·60 per cent. of copper. This is therefore a very poor one, and interesting only as demonstrating the presence of this metal in the neighbourhood.

This concludes the list of copper ores from different localities which have been submitted to examination. Most of them belong to the pyritous class of copper ores, and it is only these which are as yet found in New Zealand in sufficient quantity to work for copper.

Some of these pyritous ores are rich in copper when compared with many of the pyritous ores which are worked to a great extent in England, and most assuredly will some day be of great importance.

Color as a Guide to Richness.

In reference to the value of these mixed sulphides of iron and copper as indicated by their physical qualities, we extract the following from "*Nicol's Manual of Mineralogy:*"—"The richness of the ore, says Allan, may be judged of by the color: if a fine yellow hue, and yielding readily to the hammer, it may be considered a good ore; but if hard and pale yellow, it is assuredly a poor one, being mixed with iron pyrites." But in applying this, we must take the two tests together—the color and the hardness,—or we may be very much mistaken, as the test of color above is very deceptive, and the degree of hardness would be no certain guide by itself; for, in reference to the color test, it was found in the Laboratory that common iron pyrites, for which copper pyrites is apt to be mistaken, can at pleasure be made to assume much of the brassy appearance of this mineral, by a simple immersion of it in a weak ammoniacal solution for some time; and its former light color could be restored by acidifying the solution with hydrochloric acid,—which renders it probable that the cause of the dark color given to it by ammonia is owing to a thin film of the red oxide of iron being formed upon its surface by oxidation. The acid or alkaline state of the rocks, therefore, which are in contact with the iron pyrites, and

probably, too, their richness in organic matters, or in common air, &c., are circumstances which can greatly modify the color of iron pyrites, and very possibly, copper pyrites too, and unless we have previously acquainted ourselves with what these circumstances have been, we cannot certainly judge of these ores by their color.

IRON ORES.

Iron is one of the most universally distributed metals, and occurs abundantly in New Zealand in a great variety of forms, but the resources of the Colony in this respect are not satisfactorily ascertained.

Of the various forms in which this metal has been found in New Zealand, the following are the most important :—

Hæmatites, from veins in the schistose and crystalline rocks.

Magnetic Iron Oxide, from the schistose rocks, and also from various igneous rocks of recent origin, when it generally contains a considerable percentage of Titanium.

Argillaceous Iron Ores, from the various coal-bearing formations, occur plentifully, but were not represented in the Exhibition.

The following is a short account of the principal exhibits of Iron Ores :—

HÆMATITE, FROM DUN MOUNTAIN, NELSON.—(304).

This ore was exhibited in quantity, and in a state of comparative purity. It was easily pulverised, a property highly advantageous in the working of it.

It is one of the most valuable forms of the iron ores, and occurs in large quantities in the serpentine rock near Nelson, with many other varieties of iron ore, the mixture of which will be advantageous in smelting.

Specific gravity, 4.259 , percentage of iron, 63.40.

The following is an analysis of it : —

Silica	4.60
Alumina	3.00
Sesqui-oxide of Iron	90.60
Water of constitution	1.80
	100.

HÆMATITE.—DUNSTAN, OTAGO.

This ore was exhibited in considerable quantity by the Goldfields, and by the Geological Survey, Departments of Otago.

It occurs *in situ* on the Shotover River, near Maori Point, where it forms a bed of solid ore six feet in thickness. A large piece of this iron, taken from the solid bed, was exhibited in the collection of the Otago Geological Survey.

It is also found among the heavier matters in the operation of gold washing, and frequently it is found in small boulders, familiarly known to the Digger under the appellation of black-Maori, from its black glossy appearance and its rounded form.

It has a hardness of 6., and specific gravity, 4.912. It possesses a slight, though decided, polarity. The amount of iron contained in it is about 68.30 per cent. The following is the composition of two specimens of this ore analysed :—

	I.	II.
Oxides of Iron, chiefly the sesqui-	96.11	94.81
Undecomposed by acids	1.06	5.19
Liberated Silica	2.83	
	100.	100.

HÆMATITE, FROM HELENSBURN, OTAGO.

Several samples of this ore have been forwarded to the Laboratory at different times by Mr. Ross, upon whose property it is found. They were to be seen in the Geological Museum.

It is exceedingly hard and very compact, but varying greatly in composition; one specimen was found to contain 51·28 per cent. of iron, but the following analysis will represent pretty accurately the average composition of the better samples :—

Sesqui-oxide of iron	60·08
Alumina and water	15·04
Silicious substances and quartz	24·88
	100.

Percentage of iron 42·06; sp. gr. 3·800 to 4·100.

There were besides, several specimens of this ore exhibited in the Geological Department, obtained in the vicinity of Dunedin, occurring as large nodules, exceedingly hard, and containing crystals of quartz; but none were nearly so rich in iron as the above—the best only yielding 21·43 per cent. of this metal.

MAGNETIC IRON ORE.

This valuable ore is of frequent occurrence as black sands, and as such is elsewhere described. As yet it has not been ascertained with any degree of certainty to exist in the form of veins or beds of any size. The greater part, if not the whole, of that present in the ores above quoted, being derived from thin veins or small crystals disseminated through chloritic schist.

It does however often form a part of those large masses of hæmatite previously alluded to, conferring upon them a feeble power of influencing the magnet.

Only a few larger rolled specimens of pure magnetic iron have been collected.

This ore, when pure, yields a larger percentage of iron than any other.

When mixed with hæmatite, the iron obtained from the ore is highly prized, on account of its freedom from those deleterious substances, sulphur and phosphorus, which are so difficult to remove from the commoner ores of iron.

CARBONATES.

Fine samples of this useful ore were exhibited in the Auckland Department. Unfortunately, however, nothing was made public about the mode of occurrence, or the quantity in which it could be procured. Except small cabinet specimens to be seen in the Geological Department (Otago), no other carbonates were exhibited.

Though somewhat inferior to the oxides in its yield of iron, this ore is so easily worked that it gives it a foremost place among the ores of iron.

SULPHIDES.

Except for the extraction of sulphur, for the manufacture of sulphuric acid or sulphate of iron, these ores have no economical application in manufactures.

Though they contain a large quantity of iron, its extraction is a work of great difficulty.

BLACK SANDS.

In addition to the larger samples of iron ore sent to the Exhibition, several specimens of it were exhibited in the form of black sand, which is obtained from various alluvial deposits, and from the sand on many parts of the New Zealand coast.

Several of these black sands were carefully examined, and the following Table, VIII.* with short explanatory notes, is intended to show the relative proportion of iron which they contain.

---

* See end of Appendix A.

No. 1.—MAGNETIC AND TITANIFEROUS IRON SAND. STEWART'S ISLAND.

This is a remarkably pure Iron Sand, containing 71.50 per cent. of magnetic iron; it is non-auriferous.

The specific gravity of the whole sand as collected is 5.882, that of the magnetic part being 5.832. It occurs in large quantities on the sea shore in Port William.

No. 2.—MAGNETIC BLACK SAND. DUNSTAN DIGGINGS, OTAGO.

The greater part of this is very much affected by the magnet. It is a mixture of coarse and fine sand. It is the common black sand of the Molyneux River, and is derived from chloritic-schists principally, in which it occurs as small isolated crystals. It forms a large proportion of the wash-dirt, and is very troublesome to the digger, being difficult to separate from the gold.

No. 3.—SPECULAR IRON, OR HÆMATITE SAND. TUAPEKA DIGGINGS, OTAGO.

A very regular and fine-grained sand, only slightly affected by the magnet. It appears to be principally composed of per-oxide of iron.

No. 4.—MAGNETIC IRON SAND. MUSGRAVE'S RUN, OTAGO.

This is a very coarse sand, some of the grains being as large as swan shot. It is very much affected by the magnet, and is remarkably free from silicious impurities.

No. 5.—MAGNETIC IRON SAND. TARANAKI OCEAN BEACH.

This sand is fine-grained, and powerfully affected by the magnet.

The greater part of the impurities appear to be olivine. Several interesting specimens of manufacture from this sand were exhibited; they were said to be of excellent quality.

There are, however, considerable mechanical difficulties to be overcome in working the sand into iron, arising principally from its minute state of subdivision.

No. 6.—WEST COAST, NELSON.

Labelled No. 32. Non-auriferous, and the richest in iron of any of the Nelson sands, containing about 55 per cent. of this metal, associated with garnets of the manganesian variety.

No. 7.—TITANIFEROUS IRON SAND. HOOPER'S INLET, OTAGO HARBOUR.

A coarse, uneven sand, but slightly affected by the magnet. It did not contain gold; is sometimes known as "gem sand," from the crystallized quartz and garnets it contains.

No. 8.—MAGNETIC IRON SAND. ARROW RIVER, WAKATIPU LAKE.

A fine sand, very much affected by the magnet. The silicious substances are chiefly composed of quartz sand.

No. 9.—TITANIFEROUS IRON SAND. SADDLE HILL, OTAGO.

This was taken from a sample of the sand found upon the sea beach nine miles from Dunedin.

It is non-auriferous, and exceedingly fine-grained; it contains about 58.38 per cent. of magnetite.

This is a very similar sand to that from Taranaki, when separated from its more earthy matters.

The heavy sands obtained in the process of washing the alluvial deposits for gold, from some localities, contain, in addition to iron, a variety of garnets and other minerals, such as scheelite, cinnabar, lead, and antimony, all of which have been treated of separately in this Report.

As there is a prevalent impression that many of these black sands contain tin

ore, that metal was carefully tested for in every sample examined, but without its being met with in a single instance.

An interesting form of iron exhibited was a rusty-looking mineral, weighing about half a pound, being a portion of a Meteorolite found in the Wairarapa Valley, in the Province of Wellington. It was not thought necessary to make a complete analysis of this mineral, but only sufficient to prove the similarity of its composition with that of meteoric stones generally. The external surface of this mineral was of a rusty red color, in parts covered with exudations of chloride of iron, with a little sulphate. Freshly fractured, it showed a dark grey colour, mottled over with bright metallic-looking particles (most probably proto-sulphide of iron). The shape of the mass is an irregular pyramid with rounded edges, measuring as follows:—Height, 7 inches; length of base, 7 inches; breadth of base, 6 inches; contents, 49 cubic inches; weight, 9¼ lbs. The surface is broken by rounded indentations never exceeding half an inch in depth, evidently produced by weathering. No distinct cleavage was observed; hardness 5. to 6.; sp. gr. 8·254; moderately fusible in *blowpipe* flame to a shining black magnetic slag, with soda reaction. It was powerfully affected by the magnet, but did not exhibit any decided polarity. A little native iron was detected by the sulphate of copper test. Treated with warm hydrochloric acid, a little sulphuretted hydrogen and sulphur were liberated, with a large quantity of silica in a gelatinous form. The total amount of insoluble matters after ignition was 56·00 per cent. of the original substance, consisting principally of liberated silica; the rest was undetermined silicates. Among the soluble matters, iron and magnesia predominated; there was a little soda, manganese, and nickel. Alumina and chromium were tested for with negative results. The total quantity of iron present was 24·01 per cent.

From the preceding facts it may be assumed that this mineral is a mixture of proto-sulphide of iron with iron chrysolite, with a small amount of insoluble silicates.

The presence of native iron and nickel is almost conclusive of its meteoric origin.

CHROME ORE.

Chrome ore was one of the principal exhibits in the Nelson Court, large blocks having been furnished by the Dun Mountain Company (804) from their mines in the neighborhood of Nelson, and by Messrs. Levien and Hacket (806) from the "Black Reef Mine" in Aniseed Valley.

Small samples of this ore, found in the Province of Otago, were also exhibited in the collection of the Geological Survey.

The chrome ore, which is a mixture of chromic iron and alumina, is associated with a magnesian rock approaching in chemical composition to *Olivine*, and which has been named by Dr. Hochstetter *Dunite*; also serpentine, with a variety of other interesting rocks which were all represented in the Nelson collection.

The ore occurs in veins often twelve feet in thickness, cropping out through the serpentine and associated rocks that constitute the "mineral ground."

The samples of ore exhibited in the form of large blocks contained as much as eighty per cent. of chrome ore, but it varies much in this respect, sometimes the ore being merely represented by specks scattered through the magnesian rock.

The "mineral ground," which is marked by a scanty russet-tinted vegetation, extends in a narrow belt from D'Urville Island through the Dun Mountain and Aniseed Valley district to the Red Hills on the Wairau River, a distance of sixty miles; and it is very probable that it will yet be traced throughout the length of the Middle Island, as the same rocks have already been detected in various parts of the

Province of Otago, such as the West Coast, and near the source of the Oreti and Marirua Rivers.

Chrome ore has been exported from Nelson for the English Market to the extent of about 5000 tons.

Although the present low price has caused mining operations to be temporarily suspended, it is highly probable that the demand will soon again equal or exceed the present supply, when the former price of £10 10s. per ton will be again obtained, at which the mines can be worked profitably.

The principal expense connected with the working of the chrome mines in the Nelson Province, is that of road-making and of transport, the mines being situated in places very difficult of access.

A line of railway sixteen miles in length has been constructed by the Dun Mountain Company, which ascends to an altitude of about 2800 feet, by which, besides chrome ore, timber, limestone, and flagstones are brought down to the town of Nelson.

Other roads of considerable length have also been constructed at great expense for the purpose of bringing this ore to a place of shipment.

Chrome ore is used for the manufacture of salts of chromic acid, possessing the properties of brilliant dyes.

Formerly the decomposition of this ore was effected by nitre, but now a less expensive process is employed by using quicklime for its reduction.

The various chromium salts used in the arts were represented by preparations exhibited by Mr. T. W. Tatton of Nelson (307-2), and by a series made in the Laboratory of the Otago Geological Survey (719-723).

MAGNESIAN ROCKS.

As the recent application of *Magnesium* to the production of artificial light of intense brilliancy gives a special interest to the minerals which contain a large percentage of that metal, the various magnesian rocks exhibited from the Mineral Belt and other parts of New Zealand were subjected to analysis, though the results can hardly be considered to possess much economic value.

DUNITE.

One of the most interesting of these is the rock that was first named by Dr Hochstetter *Dunite*, and which, as before stated, is the usual matrix of the chrome ore. This mineral is of a dull, light green colour, and possesses a flaky structure and conchoidal fracture. Hardness 6, specific gravity 3·462. It is infusible alone before the blow-pipe. It is entirely decomposed, and gelatinizes by hydrochloric acid.

Of the three analyses which follow, Nos. I. and II. are of specimens from the Dun Mountain, Nelson, and No. III. a specimen from Milford Sound, in the Province of Otago:—

	I.	II.	III.
Alumina	·80		Traces.
Protoxide of iron	7·65	8·34	7·40
Sesqui-oxide of iron	Traces.		
Manganese	Not estimated		
Magnesia	47·31	48·20	41·33
Silica	40·85	40·14	49·60
Water of Constitution	1·93	1·93	1·67 (water & loss)
Chrome ore undecomposed	1·30	1·20	
	99·84	99·81	100·

SERPENTINE.

This mineral occurs in New Zealand in two forms,—Common Serpentine, that forms extensive rock masses characteristic of the mineral ground in various parts of the Middle Island, both in the Province of Nelson and Otago, and noble Serpentine, which occurs in thin veins associated with the Jade, or greenstone of the Maoris, by whom it is distinguished by the name of Tangiwai.

Large masses of this beautiful mineral were exhibited in the Geological Department (Otago), having been brought from Milford Sound, where they occur as boulders of various sizes, and generally much water worn.

Some of the smaller pieces, when cut and polished, were very attractive, on account of their beautiful deep sea green colour, their translucency, their purity, and remarkable closeness of grain.

This mineral is somewhat soft, and, breaking readily, is capable of being worked into any shape with the greatest ease, and for ornamental work generally is well adapted.

Its general characters are as follows:—Colour dull green and mottled black, lustre slightly resinous, fracture splintery, streak dirty white, hardness 4·5, sp. gr. 2·592. Is completely decomposed by hydrochloric acid. In blow-pipe flame infusible, turns faint buff colour, no distinct soda reaction, but slight reaction of manganese with the proper fluxes.

	I.	II.	III.
Silica	40·20	41·20	45·91
Protoxide of iron	12·10	12·10	1·67
Alumina	Traces	Traces	5·63
Manganese	„	„	„
Chromium	„	„	„
Magnesia	33·20	34·02	35·07
Water of constitution	12·70	12·74	12·67
	98.20	100·06	100·95

1·60 per cent. of water was driven off at 212°.

Another piece of serpentine, from the neighbourhood of Milford Sound, was found to have the following composition:—

Protoxide of iron	5·30
Alumina	Traces
Chromium	„
Lime	·40
Magnesia	37·50
Chlorine	Traces.
Soda	Not estimated.
Water of constitution	14·19
Silica	40·56
	97·95

Its color was a deep green; it felt greasy to the touch, and was considerably softer than the former, its hardness being about 3.

JADE.

This mineral, considering its rarity, was very largely represented in the Exhibition;—perhaps there has never been so valuable a collection of it before assembled.

It is ordinarily known as Maori Greenstone, or "Poenamu" of the natives, and before the introduction of metal tools among the Maoris, the hardness and singular toughness of this mineral rendered it a most valuable substitute.

One kind of the jade from Milford Sound is speckled with chromic iron. It occurs *in situ* on several parts of the West coast of Otago, as veins traversing serpentine and hornblende schist.

Two analyses have been made of this mineral, and they agree pretty closely with what has been assigned as their general composition.

Analyses.

	I.	II.
Silica	51.08	56.00
Protoxide of iron, with traces of manganese and chromium	12.43	11.13
Alumina	1.42	
Lime	9.00	9.94
Magnesia	21.35	21.96
Soda	traces.	traces.
Water of constitution	.97	.97
	96.25	100.00

OLIVINE.

The only other important magnesian mineral is Olivine, which is a mineral of frequent occurrence in basaltic rocks. A sample obtained from the Kaikorai, in the neighbourhood of Dunedin, gave indications of the existence of chromium, which, in union with oxygen, no doubt is the cause of its green color.

MANGANESE ORES.

The largest and best specimens of this ore were obtained from the Pioneer Claim, Dunstan Gorge, Otago, where it occurs in the auriferous gravels as black water-worn masses, which sometimes weigh several pounds.

A portion of one of these masses was subjected to a partial analysis, by which it was found to consist of nearly pure sesqui-oxide of manganese, with one equivalent of water. Traces of barium were also found in this mineral by the use of the spectroscope; it will consequently be Manganite. Some of these nodules are, however, veined with a silicate of manganese (Rhodonite) frequently admixed with quartz.

In the case of a specimen forwarded from Canterbury as a carbonate of iron coated with psilomelane, it was found that not only was manganese present upon the surface, but it also pervaded the whole of the mineral, principally in the form of a carbonate, also as a silicate; indeed, essentially, it was a manganese spar with but traces of iron. It is said to occur in veins and in considerable quantities. Auckland also furnished a few specimens of the oxides of manganese; they were generally pretty pure, and of the varieties Manganite, Psilomelane, Pyrolusite.

The uses of these ores are exceedingly varied. The sulphate of manganese is largely used in dyeing and in calico printing, the binoxide for liberating chlorine in conjunction with other substances, in the process of bleaching. This oxide is also employed to give certain colors to glass, and the higher oxides are used as disinfectants.

Besides these richer ores, a mixed manganesian and iron ore is also obtained from the Pioneer Claim, which was analysed with the following result:

General character.—A dark slate-colored mineral, mottled green, with black

veins of magnetite traversing it irregularly, occurring massive, in moderate sized water-worn pebbles, and taken from the auriferous drifts. It is brittle and opaque; fracture, uneven and somewhat hackly; powder, grey; hardness, 6; sp. gr. 3.954; in parts strongly affected by the magnet.

Blowpipe Flame.—Alone, fuses pretty readily to a black magnetic bead, and with fluxes shows good reaction of iron and manganese.

Analyses.

	I.	II.
Silica	25.20	24.60
Sesqui-oxide of iron	40.10	
Protooxide of „	1.20	
Protoxide manganese	18.85	
Alumina	7.20	
Copper	Traces	
Lime	3.02	
Magnesia	3.00	
Water of constitution	1.43	
	100.	

Treated with concentrated hydrochloric acid at a gentle heat until the color of the powder changed to a flesh color, there was left in two experiments respectively 60.00 and 58.00 per cent. of insoluble matters. The portion dissolved was iron, with only traces of other substances. So this mineral consists of

Magnetic iron	40.10
Impure Rhodonite ($\dot{M}n^3 \dddot{S}i^2$)	59.90
	100.00

SCHEELITE.

Scheelite, or Tungstate of Lime, is found in various localities in the Wakatipu district, Otago; but it is found in greatest quantity in the Buckle Burn. It generally occurs as a coarse, white, heavy sand, difficult to pan off in washing gold, and is called "White Maori" by the diggers. Very fine specimens of this mineral, admixed with quartz, and weighing several pounds, were exhibited in the Gold-fields Department (501), the Otago Geological Survey Department (701. M. 2), and by the Queenstown District Committee, having the external appearance of quartz boulders.

Scheelite also occurs in small grains mixed with arsenical pyrites at Waipori.

From the specific gravity of the first specimen of this mineral which was brought to the Geological Survey Department by Mr Caples, there would be about 59.35 per cent. of pure tungstate of lime, the rest would be quartz.

In the Cornwall mines this ore and Wolfram, or tungstate of iron, are frequently found associated with tin ore, but none of this last metal has yet been discovered in the sand or wash-dirt from the locality mentioned.

The metal Tungsten and its compounds are attracting a good deal of attention at the present time. It is thought by some that steel alloyed with a small quantity of this metal is much superior to any other kind of steel. Some of its soluble salts are used as mordants in the place of compounds of tin. Tungstate of lime, and tungstate of lead ore are used as substitutes for *white lead* and oxide of zinc in painting.

The salt called tungstate of soda, besides being used for a mordant, is employed to render fabrics non-inflammable. The Reports of the Exhibition of 1862, in referring to this, say,—"The clothes are steeped in a solution containing 20 per cent. of this salt and then dried, when, unlike other salts recommended for this purpose, it does

not interfere with the process of ironing, but allows the iron to go over the fabric smoothly. It is said to be constantly used in Her Majesty's laundry."

The various oxides of tungsten, too, often afford excellent pigments of different colors. Unfortunately (as observed in the same work), up to the present time most of these have only been obtained in a crystalline form, which form is unfavorable for the display of their full colorific power in its highest degree; but as the compounds of this element have not long been studied, it is very possible that not only may this defect be remedied, but many other useful combinations be discovered. Indeed, from a few hasty experiments performed in the Laboratory, certain new properties were observed sufficiently interesting and relative to this article to allow of their announcement here.

The blue oxide was found to be soluble in certain organic acids, and the binoxide in muriatic acid under certain conditions, communicating respectively magnificent colors of blue, and pink or red. These colors, however, are so evanescent, and so prone to change by oxidation as at present produced, that as yet they have simply a scientific interest.

A brilliant ruby red pigment in the form of crystals was obtained by fusing tungstate of soda with the acetate for some time, and supposed to be binoxide of tungsten; but from the pressure of other work, this substance has not yet been fully studied.

Recently it has also been discovered in this Laboratory that the metal tungsten can be substituted for tin in the substance called "Purple of Cassius," without affecting its properties for all the purposes to which it has been hitherto applied, as far at least as can be at present determined. Indeed, this new Purple of Cassius is not to be distinguished from the genuine by its outward appearance. This circumstance appears to depend upon the fact that the inferior oxides of tungsten are capable of partly deoxidizing certain gold solutions, and the tungstic acid so formed combines with the partly reduced gold to form a tungstate or mixed tungstate.

This new reaction of certain oxides of tungsten with solutions of gold is interesting in an analytical point of view, and is one that may have to be taken into consideration at times; for in testing for the presence of tin by the usual Purple of Cassius test, unless we have first taken precautions to ensure the absence of tungsten in the solution to be examined, we might be led to predicate the existence of tin from reactions which were due to the presence of tungsten.

As in the case of the tin compound with gold, this salt of tungsten is soluble under some circumstances in hydrochloric acid, and communicates the same rich ruby tint to the solution, which is opaque when viewed at certain angles.

It will be seen too that, inversely, we have in these solutions of tungsten a new and exceedingly delicate test for gold. The reaction also of these oxides of tungsten with silver and mercury is similar to that of the oxides of tin, but interesting as it is to trace out all these analogies between two metals having such great physical differences of constitution as tin and tungsten—belonging, too, to separate isomorphous families—the most important to us is this property of tungsten before instanced—that of substituting tin in the compound called Purple of Cassius, this substance being largely used in the colouring of porcelain, and the salts of tungsten being so much cheaper than those of tin.

It can be produced in its greatest purity by the method first used for its production, by boiling ordinary tungstate of soda with weak acetic acid, adding hydrochloric acid to the hot solution, and deoxidizing the tungstic acid by zinc: the clear

blue solution is then poured off, and the chloride of gold added; the precipitate when washed is the new compound.

For commercial purposes, however, some such cheap method as the following might be found to answer equally well; the proportions are necessarily omitted:—Tungstate of soda is dissolved in hot water, a small quantity of an alkali being added, if necessary, to ensure complete solution. Common muriatic acid is then added in considerable excess, and small pieces of clean iron immersed in the liquid; a gentle heat is then applied, and when the whole of the tungstic acid is reduced to the blue oxide, the mixture is poured off from any undissolved iron into a solution of chloride of gold free from nitric acid. The precipitate is well washed in water, and then with a weak solution of ammonia, to remove any excess of the oxides of tungsten, which if suffered to remain, would impair the brilliancy of the color. The product, when dried, is the new *Purple of Cassius*.

The following is a brief outline of the method that was found to be most successful in extracting the tungstic acid in a pure state from a quartziferous ore. The ordinary way is to fuse the crushed and pounded ore with carbonate of soda, and extract the tungstate of soda formed by hot water.

Method.—The ore is finely pulverised, water is then poured upon it and the mixture well stirred, and allowed to be at rest for ten minutes: the liquid and suspended matters are then poured off into a capacious vessel; the coarser residue in the mortar is again pounded and treated as before; this process is repeated until no more is left. The liquid in the large vessel is allowed to get perfectly clear, when it is poured carefully off from the deposit. The fine powder so obtained is then treated with ordinary muriatic acid, and the mixture raised nearly to boiling, and kept at this temperature for nearly half an hour; the white color of the mineral will then have changed to a perfect yellow, from the liberation of the insoluble acid; the soluble substances are then washed away by frequent decantation.

Any of the ordinary soluble tungsten salts are then produced by gently warming the mixture of quartz and tungstic acid with solutions of the carbonates of their bases.

The solution is poured into evaporating vessels and slowly concentrated, when the salt will be deposited. Should it be required to obtain well formed crystals, the solution is made acid with acetic acid before concentration, but the crystals in this case will contain an excess of tungstic acid, and will have to be treated with hot water to bring them into solution.

Several of the combinations and salts of tungstic acid above alluded to were represented in the Otago Geological Museum, along with the other chemical products manufactured from the native minerals of Otago.

PRECIOUS STONES, GEMS, &c.

Except in the instance of the great "*Australian Topaz*," nothing of uncommon value was exhibited under this head; but there was a great variety of *Agates*, *Chalcedonies*, *Rock Crystals*, *Jaspers*, and *Carnelians*, from the Provinces of Auckland, Napier, Canterbury, and Otago,—many of them exceedingly beautiful and of large size. In addition, from the latter Province, some uncut *Topazes* were to be seen in the collection from the Gold-fields' Department, as large as pigeons' eggs, translucent, and of a pure white colour. Several smaller topazes of various colours have lately come into the possession of the Geological Survey of Otago, from the neighbourhood of Waipori, where they are found in the alluvium along with *Rubies*, *Garnets*, &c.

Crystals of *Zircon* were also exhibited in the Museum of the Geological Survey, from Timbril's Gully, Otago.

The following is a list of all under this head found in the following sands, positively identified as such, and all of which were exhibited in Case M. 2 of the Otago Museum (701) :—

Cinnabar	Sulphide of mercury.
Magnetite	Magnetic oxide of iron.
Specular Iron Ore	Sesqui-oxide of iron.
Iserine Ilmanite	Titaniferous iron.
Brookite	Oxide of titanium.
Mispickel	Arsenide and sulphide of iron.
Iron Pyrites	Sulphide of iron.
Manganite	Oxide of manganese.
Scheelite	Tungstate of lime.
Chrysolite	Silicate of magnesia and iron.
Carnelian	Variety of quartz.
Garnet, mmon variety	Silicate of alumina and iron.
Olivine	Silicate of magnesia and iron.
Zircon	Silicate of zirconia.
Rock Crystal	Quartz variety.
Manganesian Garnet.	
Ruby	Alumina and magnesia.
Topaz	Fluo-silicate of alumina.
Amethyst	Var. of quartz.

From the great difficulty in identifying gems, &c., when these are very small, some may have been overlooked; and it is very probable that soon the list may be largely augmented, and New Zealand be as famous for the size, the variety, and the beauty of its gems, as for the richness and extent of its auriferous deposits.

AGATES.

It may be interesting to some to mention that along certain parts of Otago Harbour—at Arden Bay, Oyster Point, &c.—amygdaloidal basalt occurs which is rich in agates and quartz: these are separated from their matrix by the action of the water, and strew the beach in various directions. These, though very perfect and beautiful, are not of a large size, and may have escaped the notice of some. Their external surfaces assume various colours, principally green, red, &c., from the presence of a thin film of organic matter.

GRAPHITE.

The only exhibit of this mineral was from Pakawau, in the Province of Nelson.

It was exhibited in regular shaped blocks manufactured from graphite shale, a sample of which was also shown in the form of rounded masses, which are easily pulverised.

No material difference could be found in the chemical composition of the two samples, the only advantage presented by the manufactured article being its superior mechanical division, which gave to it much of that unctuous feel which belongs to the best kinds of graphite.

The quantity of ash is large compared to that in the Borrowdale graphite, but much of the graphite used in the making of crucibles contains quite as large a pro-

portion. Analysis No. I. is of the mineral sent for exhibition, while No. II. is extracted from the Laboratory books, being an analysis of a sample from the same locality, exhibited in the Otago Geological Museum.

Analyses.

	I.	II.
Carbon	37.60	30.03
Water	2.00	1.35
Ash	60.40	68.62
	100.	100.

Another sample of graphite more recently received from Nelson was found to be much superior to the previous ones and equal to the inferior graphites from the Borrowdale mine, as the following analysis will show. The ash in all these samples was remarkably free from manganese or iron.

Analysis.

Carbon	58.10
Water	2.68
Ash	39.22
	100.

Though these graphites are exceedingly useful for many purposes, there is no doubt but that their value will at no distant time be greatly enhanced, by the application of certain processes recently invented for purifying this mineral, dependent on a singular reaction of graphite or carbon discovered.

It is now many years since it was found that the waste in cutting pencils from blocks of graphite could be moulded again into a solid coherent form fit for the same use as before by simple pressure under exhausted receivers, certain precautions being taken to ensure the expulsion of the air.

When it is considered that three pounds of good Borrowdale black lead in the solid state is worth as much as two pounds of silver, it is not to be wondered at that the earnest attention of the experimentalist has been directed of late to the more impure graphites, with the view of obtaining from them a graphite equal to the best, when consolidated in the manner above mentioned.

A process alluded to is said to have realised this object, and the details of it are given in the Jury Reports upon the International Exhibition of 1862.

As it appeared to have a very important bearing upon the utilising of these inferior kinds of plumbago, this process was carefully followed out in the Laboratory.

A certain weight of the powdered graphite was placed in an iron vessel and mixed with one-sixth of its weight of chlorate of potash in the powdered state and twice its weight of sulphuric acid, a little fluoride of potassium being also added to assist in the decomposition of the silicious matters. The whole was then digested for a few hours at a temperature of 212° in a water bath. The product was then well washed by elutriation, dried, and finally ignited in a covered crucible.

Thus treated the physical characters of the graphite were greatly altered; it was rendered exceedingly soft and unctuous, communicating its peculiar mark to paper with the greatest ease. A great deal of impurity was also got rid of, and altogether he quality very much improved.

The above method is based upon the singular fact that graphite oxidizes in a mixture of chlorate of potash and sulphuric acid, and combines with a portion of

the latter, the compound being decomposed at a red heat, leaving the graphite in a state of the most minute division.

But perhaps the following method, or a variation of it, may be the best adapted for purifying the inferior graphites, as after repeated and varied experiments performed upon a small scale, it has been found to yield the *purest* product.

One part of powdered graphite shale is fused with three parts of dry carbonate of soda in a closed iron crucible, and kept in this state about half an hour. The fused mass is poured on a slab, and when cool, broken up and treated with dilute muriatic acid, until thoroughly decomposed. It is then washed from the soluble salts by elutriation, the residue, (which consists of pure graphite and hydrous silica), is then boiled with a solution of caustic soda, for a short time, until the graphite appears of a pure black color, when it is finally washed with hot water and dried.—It will then be ready for pressing into blocks, or where necessary, it can be treated by the process, for the complete disintegration of the graphite.

A sample of the Nelson graphite containing about 58 per cent. of pure graphite, treated as above described, yielded 50 per cent. upon the sample taken, of pure graphite admixed with but one per cent. of impurities. This is purer than the best Borrowdale black lead, and there is no reason why absolutely pure graphite should not be obtained in this manner.

Being unable to ascertain the cost of pressing the powder into blocks, all calculations have been refrained from, but if the present price of Borrowdale graphite was reduced to half, there appears to be left a large margin of profit.

Recently one of the packets of black lead sold by the New Zealand Plumbago Mining Company has been received, and from a careful examination of it, there can be no doubt but it will come into general demand for a variety of purposes. It is in a very fine state of division, and gives a better polish to stoves, &c., than any other yet tried. Its superiority in this respect must soon put a stop to the importation of this description of article.

It may be mentioned here in favour of the Nelson graphite for these purposes, that it is generally of the *amorphous* variety, which is indicated by the ease with which it burns.

The *crystallized* graphite, from its superior hardness, being useless as a polishing material.

In order to ascertain the relative position this Nelson Black Lead holds with regard to those hitherto used amongst us, several commercial samples of these latter were analysed, among which were exhibits from the Patent Plumbago Crucible Company, Battersea, London, long famous for the superiority of its manufactures generally.

The following Table gives the results arranged according to the purity of the samples :—

	Water.	Carbon.	Ash.
Mexican	4.10	66.90	29.00
Nelson, Sample II.	2.10	58.70	39.20
Battersea (Patent Plumbago Crucible Company)	4.20	53.20	42.60
Ceylon—pressed	3.40	42.00	54.60
Nelson, Sample I.	2.00	32.00	66.00

The Battersea and Mexican samples have a very acid reaction (which the rest have not), they would therefore be very likely to corrode iron work when frequently applied. The Nelsor Black Lead is remarkably free from iron.

CLAYS.

These were but poorly represented; two or three were exhibited in the Geological Department of Otago.

A white Clay from Tuapeka appears of superior quality; it contains a little sand, and only traces of iron and alkalies, but no lime. It is infusible in the blow-pipe flame. Another from Waitahuna is of a brownish color, due to the presence of organic matter only, and not to iron; as it burns white. It is also infusible in the blow-pipe flame, and appears to be equally free from deleterious substances as the former. Both of these should be useful for fire clays.

The Province of Auckland exhibited a substance said to be fire clay, but on inspection, it was found to be only an incoherent sandstone, mixed with pieces of lignite, and strongly charged with alum, which was visible in parts as an efflorescence.

The same Province also exhibited a small cake of Kaolin. From the state in which it was received, being already baked, it would have been rather difficult to have analysed it as a clay, but from its behaviour in the intense flame of the blow-pipe, it is without doubt a superior porcelain clay, as it gave no indication of iron or of the alkalies, and though it became translucent, with a long-continued application of the flame, it did not run, and the edges remained perfectly sharp.

Although not represented in the Exhibition, clays of all kinds suitable for pottery, and eminently so for brick and tile making, abound in every part of the Colony.

HYDRAULIC CEMENTS.

An examination was made of the Calcareous Septaria, or Cement Stones, which occur in the lower tertiary clays that crop out on the coast at Moeraki, in the Province of Otago, in order to discover whether they might be made available for the manufacture of hydraulic cement.

The same formation occurs in other parts of the Colony, but it is best known at the above locality on account of the singular appearance which these boulders present, and which attract the attention of all who travel along the beach, from their perfectly spherical form. They occur of all sizes up to 6 or 8 feet in diameter, and consist principally of a mixture of clay with carbonate of lime and iron.

Their consolidation in the substance of these clay beds must have been effected by the eccentric shrinkage which took place when their elements entered into chemical combination to form a natural cement. This is indicated by the circumstance that the fissures by which the spheres are traversed, widen towards the centres of the boulders, and are closed externally, and they are only partially filled by a subsequent deposit of crystallized carbonate of lime. The richest septaria are those of small size, but portions of even the largest will yield moderately useful cement. The following analysis is of a portion of one of the boulders free from crystallized carbonate of lime:—

Analysis.

Soluble silica	.80
Alumina and iron, partly as carbonate	8.70
Carbonate of lime	72.40
„ magnesia	.30
Insoluble in acid (clay)	17 80
	100.

Character—very hard and compact; color—mottled gray, sp. gr. 2·655; hygroscopic water, .60 per cent. at time of analysis.

This analysis shows that this specimen is capable of affording a moderately good hydraulic cement, the percentage of clay being 17.80, and that of the soluble silica .80. These proportions would, however, be a little reduced, if the septaria were worked upon a large scale, from the quantity of calc-spar present in the form of veins.

As a guide to the comparative value of these septaria, the following extract from "*Tomlinson's Cyclopedia*," articles, "Mortar and Cement," is appended—

"Limestone containing 10 to 15 per cent. of clay—poor—sets in 14 days.
" " 15 to 25 per cent. of clay—rich—sets in 2 or 3 days."

Generally, if a limestone contains less than ten, or more than thirty per cent. of clay, it will not furnish a cement.

The analysis being so far favorable, a portion of one of these septaria was treated for cement according to the system generally pursued, and the product, when moistened and worked, and finally immersed in water, set to a moderately coherent mass in three days,—thus proving by a practical test that it possesses the qualities of a hydraulic cement.

A second sample of these boulders, similar in external appearance, was also analysed, but its composition was considerably different, and when tested practically it failed to form a proper cement. The defect, as will be seen from the following analysis, arises from an excess of sandy matter :—

Analysis.

Sand	35·00
Clay	6·60
Alumina, with sesqui-oxide of iron	7·60
Carbonate of lime	50·80
" Magnesia	Traces.
	100.

Character : color yellowish,—not nearly so hard and compact as the former one, and is considerably affected by water.

ALUM.

Aluminous Shale is commonly associated with the Brown Coal formation in New Zealand, from which large supplies of Alum could be manufactured.

The following is an analysis of some of the shale that had undergone natural decomposition, and was covered with an efflorescence of alum :—

Analysis.

Sulphate of alumina	11·80
" Protoxide of iron	5·27
" Sesqui-oxide do.	Traces.
" Lime	1·31
" Soda and potash	14·60
Chlorides	Traces.
Insoluble in water	33·30
Water and loss	33·72
	100.

The insoluble matters were principally angular fragments of schist ; 66·70 parts out of 100 were soluble in water, nearly the whole of which the analysis shows is ordinary alum of commerce. This is said to exist in moderate quantity, but it has

not yet been ascertained if any such quantity exists as to make it worth while to work this substance. It generally forms an efflorescence on the rocks, which in these instances are usually soft, and present all the appearances of active decomposition.

The best exhibits in alum were furnished by the Waikouaiti District Committee, (515). It was also exhibited not only in beautiful crystals, but all the stages in the manufacture of alum from aluminous shale were well represented.

Uses.—As is well known, the principal use to which alum is put is as a mordant in the process of dyeing, and its cheapness and efficacy entitle it to high consideration.

GYPSUM.

Beautiful transparent masses of this useful substance were displayed for view among the exhibits of the Otago Geological Survey, but only by the Waikouaiti District Committee was it shown in sufficient quantity to raise a hope of its ever becoming a mercantile commodity. It was exhibited through the several stages of its manufacture, from the substance as it occurs in a native state to the finished product; and from this last several very good Plaster of Paris mouldings were made and exhibited. Their color was a good pure white, they were compact and coherent, and appeared to have set quite as well as the very best Plaster of Paris.

This mineral occurs in lenticular masses in the upper tertiary strata of marine origin, in the North-eastern part of the Province of Otago

GUANOS.

Two samples of this manure were offered for inspection,—one in the Auckland Court, from Coral Queen Island, by Messrs. Combes and Daldy, and the other from Bird Island, Tasmania, by Dr. Crowther. They were both eminently Phosphatic Guanos, containing nodular concretions of earthy phosphates, and were slightly acid to test paper. Much of the organic matter in these guanos appears to be of vegetable origin, and in neither of them was there found more than traces of ammonia. The amount of soluble salts is also very small, and it is to be feared that the same agencies which have removed so much of the soluble salts and organic matter, have also deteriorated what is left of the latter; indeed, so certain did this appear to be, that it was not thought worth while to ascertain what proportion of ammonia could be obtained by the decomposition of the small proportion of organic matter which still remained. We can, however, safely discover the high value of these manures from their extraordinary richness in phosphates, and their almost entire freedom from inert silicious matters. The small proportion of soluble phosphates is a circumstance which must be expected from what has been previously stated; and though the comminuted and porous state of the insoluble phosphates may render them much more susceptible to the action of natural solvents than is bone earth, still to realise the full value of these manures in the shortest time, we must change all or part of these insoluble phosphates into soluble, or, as the term is, "super-phosphates," by the addition of an acid.

It is well known that bones and sulphuric acid are used in this manner by the more enterprising farmers in the home country, according to the suggestion of Liebig, and with the best results. In this case the quantity of sulphuric acid requisite to turn the whole of these insoluble phosphates into super-phosphates would be about 70 to 80 per cent. of their weight in the case of Tasmanian guano, while the Coral

Queen Island guano would require a little more, from its greater admixture with carbonate of lime.

It may be mentioned that these guanos are especially adapted for the employment of this process, by their comparative freedom from carbonate of lime.

In the appended analyses the "soluble salts" are principally composed of chlorides of sodium and sulphates of soda and lime.

Analyses.

	Coral Queen Island.	Bird Island, Tasmania.
Phosphate of lime	74.20	74.98
Phosphates of magnesia and alumina	traces	traces
Carbonate of lime with a little carbonate of magnesia	8.90	traces
Soluble phosphates	traces	.30
Organic matter	7.20	14.60
Soluble salts (not phosphates)	1.40	.90
Water	7.20	8.50
Silicious substances	1.10	.72
	100.	100.

From a comparison of these columns it will be observed that the guano from Tasmania has a slight advantage over the other in having organic matter substituted for carbonate of lime, and an estimable quantity of its phosphate being already in an available form for the use of plants.

It is most probable that this difference of constitution is owing to the guano from Coral Queen Island having been more exposed to rain-fall, but it must not be overlooked that this deposit may have been unfairly sampled from the outside, which will of course be more wasted and decomposed than the interior portions, so that when properly worked as the other deposit has been, an equally good result may be obtained.

These guanos are coming more into request, especially for certain root crops, than the more nitrogenous varieties, for, though not so stimulating, they are more permanent in their action, and yield those compounds to the growing plant which constant cropping is the most likely to remove.

TARANAKITE,

A new Phosphatic mineral, Taranaki, presented by H. Richmond, Esq.

This singular mineral was mistaken for *Wavellite*, to which indeed chemically it is very nearly allied, but its physical properties are quite distinct therefrom, as unlike *wavellite* it is fusible in the blow-pipe flame and with great ease. Its hardness is also considerably less, and it is also amorphous.

It was this difference which determined the performance of a quantitative analysis of the specimen, as the other indications obtained by qualitative analysis were precisely such as would have been looked for had the mineral really been *wavellite*.

As was surmised from its fusibility, the results gave a higher ratio of phosphoric acid to the alumina than occurs in that mineral, and there was found besides a certain proportion of potash which there is every reason to believe forms a definite part of the mineral as separated from what is accidental or foreign to it.

Chemically, therefore, the appended analysis will indicate it to be essentially a double hydrous phosphate of alumina and potash, part of the alumina being replaced

by sesqui-oxide of iron. On account of these characters it has been considered to be an undescribed mineral, and named after the locality where it is found.

On careful examination a few thin seams of a dark yellowish brown colored substance, hard, translucent, and infusible, could be discovered traversing the mineral in various directions, and this was found to be true *wavellite*. In selecting the sample for analysis, these seams were however carefully avoided.

This mineral is said to occur in thin seams which occupy fissures in the trachytic rocks that form the Sugar Loaves at Taranaki, and if it could be obtained in quantity at a reasonable expense, it would be valuable as a source of phosphoric acid for agricultural purposes; for there is no reason why the addition of sulphuric acid in proper proportion should not produce equally as good a super-phosphate from this mineral as is obtained from burnt bones by similar treatment, at least for calcareous soils. One advantage in thus substituting this mineral would be that a smaller quantity of acid would suffice to effect the decomposition, both on account of the equivalent of alumina being lower than that of lime, and also because of the entire absence of carbonates in this new phosphatic earth.

Analyses.

		I.	II.
Phosphoric acid		35.05	22.80
Alumina		21.43	—
Iron, protoxide		4.45	—
Lime		.55	—
Potash		4.20	—
Soda		traces	—
Chlorine		.46	—
Sulphuric acid		traces	—
Insoluble in acid (silica)		.80	·60
Water driven off at 212°,	15.46	33.06	35·80
" " red heat	17·60		

Absence of ammonia and organic matter; has slight acid reaction.

Assuming deposits having the nature of guano to be the most natural source from which this phosphate might be derived, especially in the case of such a mineral as this, which is found occupying fissures in the most recent volcanic rocks of the country, and on the sea coast, and therefore must be of extremely late origin, we are required to discover in what manner and by what agencies the lime of the original deposit has been removed and alumina substituted, so as to present us with a mineral similar in its essential constituents to the one under discussion.

The very large percentage of water present would appear to indicate that this has been effected by chemical interchange in the moist way, as we have not the slightest proof that anhydrous phosphates of these kinds pass into hydrous forms.

Relative to the form in which the alumina is offered to the phosphate of lime, it would appear according to Professor Bischof, that it must be some other than that of a silicate, for in page 33, vol. 2, of his work on "*Chemical and Physical Geology*," he states,—"My experiments also show that it is impossible for *wavellite* to have been formed by the mutual decomposition of silicate of alumina and phosphate of lime in solution." And the same remark will apply to *taranakite*.

Now the only other probable form in which alumina in quantity would be presented to the original phosphate, is that of the sulphate or double sulphate of alumina and potash, or soda. The comparative infrequency of the pyritous shales,

or schists, which by their decomposition furnish these aluminous sulphates, and the still greater infrequency of their juxta-position with phosphatic matters, or at least their proximity thereto, is in accordance with the rarity of the metamorphosis under consideration.

It therefore became an interesting question whether or not phosphate of lime was capable of entering into double decomposition with an aqueous solution of aluminous sulphates. In order to discover this, a weak solution of alum was applied to some of the coarsely pounded phosphatic guano from Auckland, already described; after the lapse of a few minutes, the guano presented a gelatinous appearance, and it recovered some portion of its former coherence. After a period of 48 hours, the solution lost the acidity indicating the presence of alum, and when filtered and tested, gave the reaction of lime, sulphuric acid, and potash only.

This result would seem to prove incontestably that the whole of the alumina in a solution of alum can be abstracted therefrom by the phosphoric acid in guano, to make with it a hydrous phosphate; and we may safely infer that with a sufficiency of alum and time being allowed, the proportion of lime in the modified phosphate could be reduced to that indicated in the analysis of this mineral already given.

SULPHUR.

Sulphur, in yellow and slightly lustrous masses of great purity, was exhibited largely from both White Island and certain islands in the Bay of Plenty; and it is reported to exist in the former locality in large quantity, and in situations favorable for its extraction and shipment.

From the serious objections to the shipment of sulphuric acid, and the consequently high rate of freight upon it, the value of any large sulphur deposit is very much enhanced, as, with the advance of manufacturing industry, a large demand will arise in the Australian Colonies for this important and essential agent.

It is very satisfactory to know that, when desirable, we have the manufacture of sulphuric acid with all its allied advantages, in our possession; but what is more important, and which may be even of vital interest to us, is the circumstance that in sulphur we have that constituent of gunpowder which is the most difficult to obtain. The other component parts of gunpowder are much more easily procured, as the charcoal can without doubt be produced equally good for the purpose as that used at home from some of the native woods, and we have all the necessary substances for the manufacture of saltpetre.

BITUMEN.

Only two substances containing this mineral were exhibited; one, from the coast of the North Island, was a specimen of excellent Bitumen, easily impressed by the nail, and perfectly free from impurities. This is a very useful mineral, but as we have no information as to the abundance in which it is found, any further remarks are unnecessary. If this sample was found on the sea coast, there is a probability that it has been merely lost by some ship.

The second was a Bituminous Shale from the Bush Reserve, Kaikorai, Otago, and was a dull earthy friable shale of a brown color;—upon exposure, cracking considerably, but not readily fatting, and burning with difficulty, leaving a very large amount of light red ash. The coke is of a dull lead color, and imperfectly formed. As the sample arrived in a very wet state, it was allowed to remain exposed to the air in a state of powder until its weight was constant. This shale is characterised by its high percentage of volatile substances.

Analysis.

Fixed carbon	5.63
Hydro-carbon	23.87
Water	12.40
Ash	58.10
	100.

RESIN.

KAURI GUM, or more correctly Kauri Resin, was largely exhibited by Messrs Combes and Daldy, and also by Mr. Benjamin Gee. Both specimens were in the same state as that in which they were found. There were also samples exhibited of the "Prepared Gum" by the same parties.

It is an article of export from Auckland of considerable importance, and is highly prized for making certain varnishes; it has also been employed to some extent in America.

It is most frequently found buried at some depth in the ground in localities where the Kauri Pine has formerly grown. Kauri gum has been asserted to occur also in the southern part of New Zealand, proving, as it is said, that the Kauri pine flourished at one time far south of its present habitat. Up to this time among the numerous specimens of resin obtained from the tertiary formation of the South Island, not one has been found identical in its physical properties with the Kauri, upon close examination. The greatest difference is found in their fusibility, Kauri resin even becoming so plastic at a heat of 180°, or so, as to be capable of being moulded into any form, while the other resins uniformly require a much higher heat to affect them in a like manner. The specific gravity of Kauri gum is 1·047; it evolves a light and pleasant aromatic odór when heated, burns readily with a clear luminous flame, becomes electro-negative by friction, and dissolves in concentrated sulphuric acid to a red solution.

Retinite.—Large masses of this resin were exhibited in the Goldfields and Geological Departments of Otago; the former exhibits were obtained from Hyde, the latter were from Caversham, Tuapeka, Waitahuna, and the Dunstan diggings, and various other parts of the Province of Otago; also from Borneo.

It is a substance of very frequent occurrence in the Brown coals, generally in form of small nodules, sometimes, however, as short imperfect veins, or layers, and rarely in such large masses as those exhibited.

As yet no distinctive differences have been found to exist among these numerous samples. They melt without decomposition, evolving aromatic odors, and at a higher heat, burn with a smoky flame. When warmed at a gentle heat with alcohol, they become softened and are then very tenacious and adhesive; their color varies from pale yellow to a dark brown. The specific gravity of a sample from Caversham was found to be 1.049.

The following are approximate analyses of two varieties of this mineral, No. I. being from Caversham, and No. II. from Labuan, Borneo:—

Analyses.	I.	II.
Soluble in alcohol	18·87	19·18
" ether	81.13	28.92
Insoluble in ether		51·90
	100·	100·

The whole of No. I. is soluble in ether.

TANNING MATERIALS.

As Tannin is a substance of frequent occurrence in vegetable structures, it would reasonably be supposed to exist in many of the New Zealand shrubs and trees, and such has been found to be the case; but up to the present time the only plants in which the amount of this principle has been ascertained in sufficient quantity to render their adoption a substitute for foreign substances in the process of tanning, at all probable, are the bark of the Pokako (*Elæocarpus hinau*), certain parts of the Tutu plant (*Coriaria ruscifolia*), and the bark of the White Birch (*Fagus Solandri*)*.

The Pokako is, however, a solitary growing tree, a circumstance likely to prevent its use to any important extent. The Tutu plant, on the other hand, frequently occurs in natural shrubberies, sometimes extending over considerable areas.

As this plant appears a very likely substitute, several experiments were made upon it, the results of which were as follows. The tannin (or tannic acid of some) was found to be abundantly diffused in the leaves, in the old wood, in the roots, in the pith of the old wood, in the flower-stalk, the calyx, and in the crushed seed; in the outer pith of strong shoots traces of it are also found.

The amount of tannin found in different parts of the plant is given in the Table below: it is calculated both upon the green and dried plant:—

	Lost by drying.	Percentage of tannin, in natural state.	Percentage of tannin, in dried state.
1. New shoots with leaves	75	2·08	8·32
2. Roots	57	1·66	3·86
3. Last year's shoots without leaves	69	1·60	5·16
4. Old shoots and leaves	70	1·26	4·20
5. Old wood without leaves	59	1·25	3·05
6. New shoots without leaves	86	·30	2·14

From the acknowledged difficulty attending the estimating tannin in its weak solution, these figures are only offered as a near approximation to the actual amount, but they will express pretty accurately the proportionate richness of the several parts of the plant to each other in this principle.

It will be observed, by a comparison of Nos. 1 and 6, how much richer the leaves are in tannic acid than the succulent watery shoots; and again, on referring to Nos. 2 and 6, it will be seen that the last year's shoots are not so rich as the roots. From a number of experiments it was found that there was no perceptible loss of tannin occasioned by drying the plant at a temp. from 130° to 150°, the small branches could therefore be dried and stacked in the same manner as hay, without losing any of their useful properties.

A sample of the White Birch Bark from Southland was found to contain about 2·60 per cent. of tannin, which is a little more than is furnished by the Tutu plant in its natural humid state, but is considerably less if the dried plant be taken.

Two kinds of Bark were in the Auckland Court, exhibited by Mr. G. L. Cole, of Papakura (7), as Dyers' Barks. Unfortunately, neither the name of the trees they were stripped from, nor yet the locality they came from, was given.† They were the richest in tannin of all the exhibits of this kind, the white bark containing 8·60, and the red bark 6·00 per cent. of this principle.

* Exhibited by W. H. Nurse (1208) Southland.

† Application has since been made to Mr. G. L. Cole, who has supplied the following information, accompanied by leaves of the trees. Red bark—*Phyllocladus trichomanoides*: Native names, Tanekaha, Toa Toa. White bark—*Elæocarpus Hookerianus*: Native names, Hinau, Pokaka, Mahimahi."—ED.

The following percentage of tannin in the barks of certain trees will afford useful comparison; they are taken from "Musprat's Chemistry applied to the Arts and Manufactures."

Young oak bark, spring cut,	22 per cent.	of tannin.
" "	15.	"
" entire bark ...	6.	"
Willow, entire bark.........	6.8	"
Elm	2.9	"
Beech	2.0	"
Larch	1.6	"

Many other New Zealand plants are known to contain a marked amount of tannin, of which the principal are the Manuka (*Leptospermum*), Rata (*Metrosideros*), Fuchsia tree (*Fuchsia excorticata*), Matapau (*Myrsine*), Red Birch (*Fagus Menziesii*).

A few remarks may not be out of place with regard to the poisonous principle of the Tutu plant, which has so often been productive of fatal results. Most of the standard processes for the detection of organic poisons have been tried, but they have failed to give any decisive results. A very bitter substance in small quantity has been however obtained by the following new process, which has the advantage of doing away with the necessity for the application of a heat to a greater degree than 90° Fah. Anhydrous sulphate of soda is added in considerable quantity to an infusion of the bruised leaves in water slightly acidified with hydrochloric acid, and at a temp. of 90° Fah. When no more of the salt is dissolved, the solution is cooled down to 60°, and set aside to allow the salt to crystallize. When this is completed, strong alcohol is added, and the whole placed in a bottle and well shaken.

When the alcohol has risen to the top, it is tested for its reaction upon test paper; if alkaline, more of the acid is added, and the whole well shaken again.— The alcohol is then poured carefully off from the crystals, and evaporated to dryness at 90°. The residue thus obtained is stirred up with a little water, and potash added, in slight excess. The mixture is then placed in a stoppered bottle, and shaken with a small quantity of ether, as in Stas' method, the etherial solution which rises to the top is then poured on a watch glass, and allowed to evaporate. The residue from the evaporation is the bitter principle of the Tutu alluded to. This substance is soluble in ether, in alcohol, in acid, and in water, only feebly so in the latter, but communicates to it a pure bitter taste of great persistency. It will be seen that this substance has the action of a true alkaloid, but unfortunately as yet it has not been procured in sufficient quantity to enable us to ascertain its precise nature.

It was thought this substance would be found in larger quantity in the ripe fruit, but although it is also easily found here, it does not appear to exist in a larger proportion than it does in the leaf. Possibly the very imperfect development of the fruit last year, when these experiments were tried, may account for this, and another season the attempt to extract the alkaloid, in sufficient quantity to study its properties, may be more successful.

In reference to this new application of dry sulphate of soda, it does not appear improbable that the power which this and similar salts have in clarifying thick organic solutions, &c., by abstracting a portion of their water, may be turned to account in filtering these preparations for the detection, separation, or estimation of certain of their constituents.

FIBROUS MATERIALS.

The various vegetable tissues that might be, or are at present, employed in the manufacture of paper and woven or spun fabrics, were well represented by collections of samples from all parts of the world; and as those from foreign localities are described in the Jurors' Reports devoted to this class of exhibits it is only necessary here to allude to those produced in this Colony. . These, though few and crude as compared to the splendid collections exhibited by the Indian Department, by Dr. Lauder Lindsay, Mr P. L. Simmons, and others, nevertheless have great significance, as they serve to illustrate how much can be effected with the fibres indigenous to this Colony by means of manual labor or only very imperfect machinery.

The most interesting and valuable of the fibrous plants of New Zealand is the *Phormium tenax*, which yields the well known New Zealand Flax, from which so much has frequently been expected as an article of export on which the capital and skilled labor of the Colony could be largely employed. For various reasons, however, although large quantities of the fibre of this plant, prepared by native labor, have been exported, and its value in the home market fully established, no attempt to employ machinery for its production has yet been a commercial success. For full details respecting the varieties and general properties of the New Zealand flax plant, reference may be made to the Report on Classes IV*c* and XXIX*d*; but as the following notes respecting its growth in the natural state have an important bearing on its practical use, they may properly be inserted here.

This plant grows in bunches or groups of plants or shoots, each shoot has five (5) leaves. Ten (10) of these shoots go to a bunch on the average, or, in all, fifty leaves. These vary according to the soil, from five to ten feet in length, and each consists of a double-bladed leaf, which, when closed, is from two (2) to four (4) inches wide. The lower part of the outer leaves forms a complete sheath or flattened tube, and it is from this portion of the leaf that most of the gum exudes, and where the fibre is of least value.

On rich "flax land" there are over 2000 bunches of flax to the acre, or 100,000 leaves. When sun-dried, these leaves, after cutting off the gummy and useless lower parts, weigh about five to the pound, so that an acre of ground will yield nearly ten tons of dried leaves. Assuming the outer leaves only to be taken, the quantity will be reduced to four tons. Now, from experiment, it was found that 23.10 per cent. of apparently well cleaned fibre could be obtained from green flax when all loss was avoided. Mr. Honeyman, of Dunedin, however, only produces about twelve per cent. of fibre exclusive of tow. We may therefore safely anticipate a yield of fifteen per cent. upon these four tons, since they will have gained by their desiccation an additional four per cent. of fibre, calculated upon a loss of fifteen per cent. of water. This will give of clear fibre about twelve per cent., or three-fifths of a ton only taking the outer leaves. Respecting the proportion of tow to be added to the good fibre no certain data have been obtained; but, in ordinary flax the weight of tow is about equal to that of the clean fibre, and from the different character of the New Zealand flax we may expect the proportion to be a good deal less.

On hill land, owing to the shorter growth of the leaves, and the wider intervals between the groups of plants, the yield will not average more than three tons to the acre.

The quantity and quality of the flax crop could no doubt be greatly increased by artificial culture, and with any permanent establishment for the manufacture of

the fibre, it would no doubt be found necessary to undertake the cultivation of the plant, instead of depending alone on the natural supply in the wild state.

The method employed by the Natives for cleaning the fibre is by simply scraping it with a shell or knife when in the fresh green state. By this means a fine quality of fibre is obtained, but only a very small proportion of the whole quantity in the leaf, so that the great loss of material and waste of labor involved in the operation makes it suitable only for the production of such small quantities of fibre as are required by the Natives themselves.

Ever since the foundation of the Colony, attempts have been made from time to time to supplant the native process for the preparation of the flax fibre, by other of more economical application, but as yet, so far as is known, without any successful and practical result; and it is to be regretted that no information was furnished regarding the methods employed in preparing the various samples of fibre that were sent for exhibition, as without such explanation it is impossible to form any opinion of the merits of the samples as indicative of a successful solution of the problem.

The relative intrinsic merit of the various samples of fibre is scarcely within the province of chemistry to determine, as those tests which would alone determine them are entirely mechanical, such as the tension the fibre can bear, and the injury it sustains from torsion.

Even without these trials, which would have required peculiar mechanism for their application, it was quite evident that of all the various samples exhibited, those that had been prepared without the use of chemical re-agents, and especially by the simple method employed by the Natives, were the most superior, in so far that they preserved the qualities of lustre and strength in the highest degree.

In the general absence, therefore, of complete and detailed descriptions of the methods used, we are induced to communicate the results of a few Laboratory experiments, with the methods by which they were obtained. They were instituted especially for the purpose of ascertaining the precise action of certain chemicals upon the Flax plant, and although much of this work will have already been performed by others, some portion may be new, and the whole will possibly have an interest and a value from the care and exactness with which it has been endeavoured to conduct the enquiry.

Mechanical Preparation.—It was found absolutely necessary to commence the process by bruising the leaves. The leaves chosen were about seven feet long, from old plants, and the whole of the leaf was taken except about one foot of the base. The double leaf was placed upon a smooth block of hard wood, and smartly struck over every part with a hammer, the iron head of which had its flat striking part rounded off at the edges to prevent the cutting of the fibre. By this process the bundles of fibres in the thick part of the leaf are easily separated from each other, but the top part of the blade from its thinness is much more difficult to break up.

Gum.—A few preparatory experiments were first made upon the gummy matter which exists in the sheath of the leaf, and has generally been erroneously considered to be a gum-resin. Nevertheless, it is the presence of this gum that is certainly the principal cause of the difficulty in preparing the fibre.

This gummy matter was found to be soluble in water, though only very slightly affected by it when cold, and even hot water fails to dissolve it completely, and unless the solution is very dilute it thickens on cooling to an opalescent jelly.

When this gum has been once dried it is very difficult to re-dissolve it, and probably it is this circumstance which tends most to injure badly prepared flax, for

when dry the gum is very hard, and must cut the delicate fibres of the flax like a knife when they are twisted in process of manufacture. Moreover, if the gum is not completely extracted, articles made of such flax, if kept damp, will speedily decompose and rot.

The gum was further found to be insoluble in alcohol, and it is also as insoluble in caustic alkali, carbonated alkali, or solution of soap. Indeed a clear solution of the gum was rendered turbid and thick by the addition of either of these; but if a very small quantity of acid—sulphuric acid for instance—was added to a thick opalescent mixture of the gum with water, a transparent limpid solution of it was obtained, the whole of the gum being dissolved, with the exception of a few flakes of gelatinous substance which float freely about in the liquid, and which are probably nitrogenous matters.

These results being so far favorable in regard to the use of acids, experiments with these were first tried upon the flax.

Action of Sulphuric Acid.—Three ounces of the bruised leaf were warmed up with twenty ounces of water, and two grains of concentrated sulphuric acid, previously diluted with water, were added. But this quantity was found insufficient to produce any result, even on long boiling, and the quantity of acid had to be increased to eight grains before any decided effect took place. With this quantity the green color of the leaf was turned brown, the solution also was colored. Other three ounces of the leaf were therefore taken and treated with eight grains of sulphuric acid as before, and after boiling the whole for two hours, it was found that every part of the leaf was easily scraped clean by the nail, and the fibre did not appear to be damaged; it was, however, very harsh and inflexible.

Further experiments proved that, if the boiling process was kept up much longer, or if the amount of acid added to it was largely increased, the fibre was greatly damaged.

Action of Hydrochloric Acid.—Hydrochloric acid was then substituted for sulphuric, with precisely the same results.

The effect of an organic acid was next studied.

Action of Oxalic Acid.—Oxalic acid was selected, as from its being in a solid form, more exact quantities could be employed. 1516 grains of the leaf were placed in 20 ounces of water, and boiled with 20 grains of crystallized oxalic acid, and digested for three hours, when the leaf was so much affected, that it was easy to scrape it clean with a blunt instrument This treatment did not impair the strength of the fibre at the time, though afterwards its strength seemed to decrease. The fibre obtained was bright and lustrous, and of a grey color, but still harsh and inflexible, and as was the case with the mineral acids, an increased quantity injured its strength. It was therefore evident that the use of organic acids possesses no special advantage over that of the cheap mineral acids.

The action of Alkalies upon flax was next tested.

1120 grains of flax were put into 30 ounces of water, and one per cent. of caustic potash added, and the whole warmed for four hours, or until the leaf would scrape clean with the nail. In this case, though the fibre was clean it was very tender, and and no matter how the quantities were varied, no useful result was obtained; for simultaneously with the cleansing of the fibre, there was a weakening which could not be avoided. The same results were obtained when carbonate of soda was substituted for the potash.

These results are difficult to reconcile with what is said about the non-detrimental effect of stronger solutions of the alkalies, than those employed as above,

upon linen goods in the process of cleansing them for the bleacher, but probably the fresh fibre of plants is more easily affected by the action of alkalies, than the same fibre after passing through the various operations used in preparing it for the manufacturer.

The action of Oil was next tried. The dry leaf was heated with it for some hours, but no advantage was gained, the leaf remaining unaltered.

The action of Alcohol was then observed: though the high price of this re-agent would of course prevent its use, even if the re-distillation of it from waste solution for further use, was resorted to.

An unbruised leaf was found to be merely decolorised by the loss of its chlorophyle, the external varnish being first removed, nor was the *bruised leaf* more favorably affected, the gum as before stated, being quite insoluble in alcohol.

Action of Soap.—The last chemical experimented with was soap; its solvent powers upon many fatty and resinous substances being well known, and also the unsparing manner in which it is used upon many delicate fabrics, without injuring them.

A certain portion of the bruised fibre was taken and digested in hot water for two hours. It was then boiled two hours longer with 12 per cent. of common soda soap, before it affected the leaf so that it would clean with the nail. The fibre so obtained when scraped, appeared to be everything that could be wished for, being remarkably soft and flexible, but with a faint shade of green color, indicating probably that no decomposition of the fibre had taken place. When the sample of fibre so prepared had been kept for one year, it appeared to be equally as strong as at first. And indeed flax so prepared four or five years since, still remains unaltered, from the state it was in when first dressed.

A much larger quantity of soap did not hurt the fibre, hence its use is free from those objections which attach to the use of acid or alkalies. The high priceof the soap, however, would entirely prevent any adoption of this process, as it would entail a cost of twenty pounds upon every ton of clean fibre. The expenditure of soap, however, can be greatly reduced in two ways. 1st. By washing the flax repeatedly in warm water, and then adding the soap to the necessary amount. 2nd. Before adding the soap, by neutralising with carbonate of soda, the water in which the flax has been boiled as it acquires an acid reaction. In each case the proper quantity of soap is that which gives to the warm solution a permanent froth upon its surface when stirred about. The first process of washing is preferred on account of its greater cheapness, and also because it avoids the danger of using the excess of alkali to which the latter is subject. In regard to the second process, the quantity of alkali necessary will vary with the season, but, at the time of the experiment (autumn), 3.5 per cent. of common washing soda, or 1.3 per cent. of the dry carbonate of soda was found to neutralise the acid substances of the flax. In either case about one or two per cent. of soap would be necessary. The cost of chemicals would be £4 to £5 to produce each ton of clean fibre by the first process, when soap is used alone; and by the second or neutralising process, about £6 or £7. As will be inferred, an abundant supply of hot water is necessary. Perhaps the readiest and most economical way to maintain this would be to connect the steam pipe of a boiler with a perforated coil lying at the bottom of the vat or tub in which the operation is carried on.

The next process tried was *Fermentation*. It has been thought by some that possibly flax might be worked profitably for alcohol, but as it was found to contain but 1 to 1¼ per cent. of sugar, (grape sugar), even in the autumn, it would not answer at all for this purpose.

It was, however, attempted to turn this process to account in the manufacture of prepared fibre in the following manner:—The bruised flax was treated with hot water and allowed to steep therein for three hours at 130°; sulphuric acid in the proportion of two grains to the ounce of flax being previously added, to facilitate the change of the gummy matters, starch, &c., into sugar; the object being to ensure a good and rapid ferment, in order to break up the cells of the plant, if such was possible. The whole was then cooled down to 80°, and yeast added; fermentation soon commenced, and went on pretty fast, but when completed the fibre was found to be still difficult to clean, although considerably altered.

The liquor from the preceding experiment was perfectly clear, of a pale yellow color, and had to a remarkable extent the odour of *bitter beer*, and undoubtedly a kind of beer could be made from a strong infusion of flax mixed with a moderate quantity of sugar, and then fermented. The bitter principle of flax is a very pure intense bitter, capable of being retained by charcoal, by which it is given up to alcohol and might be used to communicate a bitter taste to beer in the absence of hops. It would at least be less objectionable than drugs that are said to be used for this purpose.

Retting.—The last process tried was *retting*, to which process the varnish on the outer part of the leaf has hitherto proved an insuperable obstacle.

It was thought, however, if the leaves were first broken up by rollers or stampers, so that the gummy matters which bind together the flax fibres could be placed at once in direct contact with water, these would soon enter into a state of decomposition and communicate this to the more inert portions of the plant, and which, if stopped before it had extended to the fibre of the flax by its removal from the solution, would give us a product as nearly similar as possible to the home flax just after *retting*, and consequently in a fit state to be scutched, with its natural strength of fibre but little affected. Several experiments were therefore made to test this, and some of the results certainly appeared to be very favorable.

The following is a brief description of the particular methods employed:—

As nearly as possible the first experiment was made to approximate to the ordinary process of retting generally adopted, excepting that the leaves were first well bruised. One week after immersion in water the flax was nearly as green as ever, and even three weeks after the commencement of the experiment no decided change in its texture could be discerned, though its green color had by this time given way to a pale yellow. At this stage the experiment was broken off, on account of the coldness of the weather. No opinion can, therefore, be formed of the value of the common retting process upon *bruised* flax; other experiments at a more favorable season of the year are necessary.

In another case the flax, bruised as before, was heated to a temperature of 150° Fah. and then set aside. In one week after the leaf appeared to be much modified, and in a few days more it could be cleaned pretty readily while still moist from the liquid, the strength of the fibre not appearing to have been in the least degree impaired. During the latter portion of the retting, gas was given off in some quantity attended by an unpleasant smell.

Lastly, another portion of the bruised flax was heated with water to a temperature of 150° Fah. for a short time, after which the temperature was allowed to fall to 100°, at which it was kept for twelve hours, and though suffered to cool each night, was warmed to the same degree each morning, and kept at this for the remainder of the day. By this means the length of time which the operation required was greatly reduced, and the product was even more readily cleansed than before.

There is one circumstance especially worthy of note in these results—viz., the ease with which each bundle of fibres can be resolved into the separate hair-like filaments which compose them; by no other process was their coherence so far reduced.

On reviewing these experiments, we find that acids generally, have the property of rendering the gummy matters which bind the fibres together soluble; but though this makes the leaf more easy to clean, still there is always a hardness and an inflexibility in the fibre so prepared which must prevent its adoption. In addition, there is a danger of hurting its strength, and unless washed with great care, the result would be its gradual deterioration.

Oil, as might be expected, has little or no action. Alcohol, even if it could be economically employed, is useless, as it exerts no decided action upon those substances which have to be removed.

The use of caustic, or carbonated alkali, alone, though very beneficial in some respects, is very objectionable in others. They enable us to clean the fibre with ease, but at the same time they impair its strength, always indeed imparting to it a brownish tint, which can scarcely be looked upon as other than a sign of decomposition.

In the use of the last chemical experimented on, soap, we have all the advantage obtained by the use of the alkalies above, without their disadvantages, but the high price of this article would prevent its adoption for this purpose if used alone. If, however, as before stated, the acid of the flax was first neutralised with carbonate of soda, the use of a small quantity of soap would effect the rest without incurring the least danger or adding much to the expense of the operation.

The fibre obtained in this way is easily cleaned, is not discolored, and appears as strong as that prepared without the use of chemicals.

The only remaining process requiring comment is the modified *retting* process, and which, in our opinion, is likely to be the most promising, as it involves no expense in chemicals and but little in fuel. When properly performed it will, without doubt, give results equal to those obtained by any of the other processes, and in one respect superior—the woody tissue which binds the fibres together in bundles being in this case so much affected by the decomposition of the gummy matter, that it offers little impediment to the splitting up of these coarse fibres into hair-like filaments by the hackling machines.

Moreover, in comparing this process with those where the application of chemicals is mainly relied on, or where machinery is the only aid, it will be well to bear in mind that, of the many ingenious methods invented to supplant the ordinary retting of the common flax plant, not one of them has been adopted on an extensive scale; for, though they effect a considerable saving of time, the manufacturer finds there is a deterioration of the product, and prefers the flax which has been prepared by the old process. It is, therefore, not unlikely that so long as attempts are made only by chemicals and machinery to prepare the New Zealand flax for the market, we may never be able to obtain for the fibre that consideration from the manufacturer which the superior strength of the raw material should entitle it to.

The retting process which may, therefore, be recommended as the result of the foregoing enquiries is as follows:—

In the first place, there is the absolute necessity that the leaves of the plant should be thoroughly bruised. Of the numerous machines which have been proposed for effecting this, we decidedly prefer those which employ the use of stampers, feeling confident that, with the same amount of power, sudden impact will effect more than simple pressure.

Secondly, the bruised flax must be placed in vats of water till it rots; may be found more convenient in the colder parts of the Colony to accelerate the commencement of decomposition by the use of artificial heat. The decomposed leaves should then be washed by being placed in a running stream, after which the flax is ready for scutching in the ordinary manner. There can be no doubt as to the success of this process, and the only additional expense over that necessary for the preparation of the ordinary flax is the preliminary bruising of the leaf. When the price of labour in the Colony is reduced from the existing high rate of wages, and the New Zealand flax plant is systematically cultivated, the above process should allow of the production of a valuable quality of fibre for which there would be a steady demand with a large profit.

Of the other sources of vegetable fibre indigenous to the Colony, no special mention is required in this Report, as, with one exception, they were not experimented upon. This was the case with certain specimens of fibrous grasses* belonging to the genera Triticum, Agrostis, Arundo, and Danthonea, which are represented in the official Catalogue page 71, as being suitable for the manufacture of paper.

In the grass experimented upon the proportion of fibre to the *boon* or woody matter was found to be per cent. upon the weight of the grass when green, and per cent upon its weight when dried at 212° Fah.

These grasses are abundantly spread over the grassy hills of Otago, at altitudes over 1000 feet. If the article should become one of export, the cost of conveyance to port would be heavy, unless means could be applied up country to compress it into bales. At some future time, however, machinery could be erected where water power is convenient, and the manufacture of an inferior description of paper could be carried on in the country.

With regard to the application of New Zealand flax fibre as a material for the manufacture of paper, there can be little apprehension on the score of its adaptibility for this purpose when properly prepared. Attention has already been directed to this subject at a very early date, as there were a few sheets of paper exhibited by Wm. Colenso, Esq., of Hawke's Bay, manufactured in 1838 from the fibre of the Phormium Tenax. There was also exhibited by the same gentleman a small book entitled "Murray on Phormium Tenax," the paper of which was made entirely of this material. Mr. Thomas Kirk, of Auckland, also exhibited a book printed on paper manufactured from the New Zealand flax fibre. A quantity of pulp, prepared for manufacturing into paper, was exhibited by Robert Cameron of Canterbury.

The production of pulp for paper from the flax plant is very easily effected, and in the process of manufacture of clean fibre, much of the waste material might be profitably converted to this use.

AMOUNT OF FIBRE IN NATIVE BUNCH GRASS, COLLECTED FROM THE HILLS BEHIND DUNEDIN. (AGROSTIS, SP.)

Contained 20.25 per cent. of water. After boiling with soap for five hours there was a residue amounting to 56.38 per cent. on the grass, after drying at 212° Fah., of clear fibre, with a small quantity of boon or woody matter. (The remainder would represent the loss incurred in the operation, of albumen, oily matters, sugar gum, &c.)

The fibre was not at all calculated for making rope, but would no doubt do excellently for paper making.

* See Jurors Reports, p. 124.—ED.

ANALYSIS.

Water	20.25
Fibre and boon	56.38
Other matters	23.37
	100.00

QUALITATIVE ANALYSIS.

In addition to the Quantitative Analyses of Minerals that have been given in the preceding part of this Report, many others were determined by a partial analysis and by an examination of their physical properties. It has, therefore, been considered necessary to give a complete list of all minerals which have been determined in the Laboratory, and which occur in New Zealand.

METALS AND ORES.

Gold, native—nearly pure	Moeraki.
„ alloyed with silver	„ imbedded as grain in cinnabar.
„ „ „ copper	„ auriferous drifts.
„ „ „ mercury (amalgam)	Waipori.
Silver	„
Cinnabar	„ and in alluvial deposit, Obelisk Ranges.
Magnetite (magnetic oxide of iron)	As black sand, and rolled; frequent in the alluvial drifts; as crystal and masses imbedded in chloritic schist, gneiss, and other metamorphic rocks.
Hæmatite, specular iron ore	As iron sand, and as being in the crystalline rocks and schists west of the Lakes.
Glauconite, silicate of iron	In certain schists, and in the middle tertiary or green sand series.
Iserine } Ilmanite } Titaniferous iron	In black sand of various parts of the coast, and in some of the rivers.
Brookite, oxide of titanium	In trap rocks at Otepopo.
Iron pyrites, sulphide of iron	As large crystal—in coal, quartz, &c.
Mispickel, arsenical iron	In diorite and magnesian felstone, Milford Sound; also in alluvial drifts elsewhere—Waipori, &c.
Chromite, chromic iron	Milford Sound, in serpentine, &c.
Vivianite, phosphate of iron	As crystals on moa bones, Botanical Gardens, Dunedin, &c.
Siderite, carbonate of iron	In cavities in the contorted schists.
Sphærosiderite	In basalt.
Clay iron ore	In brown coal series.
Manganite, oxide of manganese	Veins in the schists, and as rolled fragments in the alluvial drifts of the Kawarau and Clutha.
Rhodonite, silicate of manganese	Occurs with the manganite.
Stibine, sulphide of antimony	Arrow River.
Towanite, sulphide of copper	Moke Creek, in a lode.
Copper pyrites with iron pyrites	„ „
Silicate of copper	In schists, West Coast and the Dunstan.
Oxide of copper	Tokomairiro.

Malachite, green carbonate of copper	Waitaki, Pomahaka, Kakanui Mts., Moke Creek.
Peacock copper ore	Dunstan.
Native copper	From 15 miles up the Kawarau, by Mr. John Klass
Cobalt Bloom, arseniate of cobalt	In schist and gneiss rocks, West Coast.
Galena, sulphide of lead	In the Rough Ridge schists.

QUARTZ AND ITS VARIETIES.

Quartz, crystallized rock crystal	In reefs, &c., in schists .
,, amorphous	
Agate	In porphyritic rocks, Harbor side, &c.
Jasper	In volcanic rocks at Moeraki and Otepopo.
Plasma	,, ,,
Chalcedony	,, ,,
Carnelian	,, ,,

SALTS OF LIME.

Dog-toothed carbonate of lime	In limestone, Moeraki, &c.
Iceland spar (carbonate of lime)	As crystal in limestone, marble, &c.
Arragonite ,,	In cavities in basaltic rocks, Dunedin, &c.
Gypsum, sulphate of lime	In Moeraki clays, crystallized.
Scheelite, tungstate of lime	Found by Caples on the Rees River, Wakatipu Lake.

EARTHY SILICATES.

Chlorite	In schists, also found amorphos in the vesicular basalt at Otago Heads and elsewhere.
Muscovite, potash mica	In schists and gneiss.
Biotite, magnesian mica	West Coast.
Margarite, pearl mica	In schists and in gneiss.
Lepidomelane, black mica	
Garnets (manganesian variety)	In the gneiss-granite and quartzites of the West Coast.
Iron and lime garnets	Kakanui river.
Epidote	In the gneiss-granite and granulites of the West Coast.
Phrenite	In the trap rocks of Moeraki and Otepopo.
Orthoclase, potash-felspar	In all schists, and crystalline in basaltic rocks and granites.
Labradorite, lime-felspar	In the trachy-dolerite, Flagstaff Hill.
Albite, soda-felspar	In the diorites of the West Coast.
Tourmaline	In the granite and gneiss of the West Coast.
Lithia-mica	In the marble of Thompson's Sound.
Lepidolite	In the West Coast gneiss.
Chrysolite	In the basalts of Saddle Hill and elsewhere.
Olivine	In basaltic rocks, and at Milford Sound.
Serpentine	Milford Sound.
Nephrite, Jade, or Maori Greenstone	Ditto, also in a rolled pebble from the Silverstream.
Asbestos, Fibrous Hornblende	Milford Sound.
Steatite, Silicate of Magnesia, &c.	Ditto.

Schiller-spar, pyritous	West Coast.
Augite	In basalts round Dunedin.
Diallage	In dioritic rocks on the West Coast.
Bronzite	Ditto, ditto
Hypersthene	Ditto, ditto
Hornblende	Veins in syenitic and older rocks.
Tremolite	In rocks at Milford Sound.
Chabazite, Zeolite	In vesicular basalts around Dunedin.
Gmelinite	Ditto ditto
Natrolite	Ditto ditto
Mesotype	Ditto ditto
Halloysite	In decomposing basaltic rocks, Dunedin.
Kaolin, porcelain clay	Manuherikia Plains, Arrow River, &c.
Talc	In quartz, West Coast.
Zircon, silicate of zirconia	Timbril's Gully.
Topaz, silicate of alumina	Waipori..

MISCELLANEOUS MINERALS.

Alunogene, sulphate of alumina	In some brown coals.
Alum, potash variety	In shale, Tokomairiro.
Epsom salts, sulphate of magnesia	As an efflorescence, Murison's station.
Retinite	Caversham, in brown coals.
Ozokerite, fossil resin	Dunstan, in brown coals.
Graphite	In the schists, and as scales in marble from the West Coast.

NOTE.

It has been found requisite to print Table II. on the opposite page out of its regular order; that Table I., which occupies four pages, may not be unnecessarily broken up. Table I. will be found on pages 440-3.—ED.

TABLE II.—ABSTRACT OF FIFTY-SIX ANALYSES OF COAL OF NEW ZEALAND,

MADE IN THE LABORATORY OF THE GEOLOGICAL SURVEY OF OTAGO.*

The characteristic composition of the several classes into which the samples analysed may be divided, may be gathered from the following Table, which gives the average of all the analyses of all closely allied samples of Coal.

FORMATIONS.	Percentage of HO on C & HC	Specific Gravity	Fixed Carbon	Gas	H O	Ash	FC	Gas	Coke	Sulphur	COLOR.	
											Powder.	Streak.
Great Brown Coal Formation (Miocene?)	18·03	1·109	42·63	37·24	14·71	4·24	53·55	46·24	45·15	3·17	Dark Brown	Light Brown
Upper Bituminous Formation, Upper Mesozoic	7·55	1·070	50·77	34·87	·32	7·19	58·59	41·40	63·04	3·48	Do	Black
Lower Bituminous Formation, Lower Mesozoic	2·34	1·314	57·00	33·90	2·20	4·89	61·57	36·85	64·14	1·90	Black	Do
Abstract of Analyses of English Coals.—Palæozoic	·55	1·279	61·29	34·02	1·48	3·21	64·31	35·69	64·50	0·82	Do	Do

* Shewing the relation that exists between the Geological age of the various Coals, and their average Chemical composition.

TABLE I.—COALS.

ARRANGED ACCORDING TO THE PROPORTION OF WATER UPON THE CARBONACEOUS MATTERS.

No.	LOCALITY.	Percentage of water, after deducting ash.	Specific Gravity.	Percentage of Fixed Carbon.	Percentage of Volatile Matter.	Percentage of Water	Percentage of Ash.	Color of Ash.	Percentage after deducting water and ash. Fixed Carbon.	Percentage after deducting water and ash. Volatile Matter.	Percentage of Coke.	Sulphur.	Color of Powder.	Nature of Coke.	Percentage of Water when first examined.	Action of Potash. 0·10
1	Green Island, Otago	26·14	12 90	43·12	34·37	20 26	2·25	Light Buff	55·64	44·36	45·37		Dark Brown	Dull	30·00	
2	Saddle Hill, Otago	25·11	1·294	41·15	35·87	19·34	3.64	Pure White	53·43	46·57	44·79	2·13	Dull Brown	Do	27·08	
3	Green Island, Otago	24·37	1·248	38·24	37·53	18·45	5·78	Light Buff	50·47	49 53	44·02	2·24	Dark Brown	Do	26·60	
4	Clutha, Otago, Jet Coal	23·66		41·83	29·61	16·43	12·13	Red	58·55	41·45	53·96		Dull Black	Iridescent	22·04	
5	,, ,, Bottom of Seam	22·64	1·275	41·38	35·92	17·50	5·20	White	53·53	46·47	46·58	3·85	Light Brown	Dull	28·34	
6	,, ,, Middle ,,	20·69	1·267	41·32	37·67	16·35	4·66	Do	52·31	47·69	45·98	4·22	Dull Brown	Do	25·22	
7	,, ,, Top ,,	20·52	1·279	40·02	38·27	16·10	5·61	Do	51·12	48 88	45·63		Dark Brown	Do	20·42	
8	Saddle Hill, Otago	17·04	1·294	42·39	41·04	14·22	2·29	Do	50·81	49·19	44·68	2·32	Dull Brown	Do	28·15	
9	Watchman, Auckland	16·78	1·315	41·10	41·70	13 90	3·30	Do	49·59	50·41	44·40	·60	Dull Black	Unchanged	13 90	
10	Matakana, Auckland	16·61	1·309	48·96	36·25	14·15	·64	Do	57·45	42·55		·28	Dull Black	Do	14·15	

TABLE I.—COALS.—*(Continued.)*

11	Morley Creek, Southland	16·01		51·40	30·30	13·10	5·20	Red	62·91	31·09	56·60	·30	Black	Unchanged	18·40
12	Oamaru, Otago	15·99	1·246	39·10	44·70	13·40	2·80	White	46·64	53·36	41·90		Dull Brown	Lustrous	13·40
13	Tokomairiro, Otago	15·56	1·256	35·77	34·93	11·60	5·90	Do	50·54	49·46	41·67		Do	Semi-metallic	23·40
14	Clutha, Otago, Top of Seam	15·58	1·282	46·77	36·68	12·94	3·64	Do	56·06	43·94	50·41	3·63	Do	Dull	26·12
15	Waikato, Auckland, Block	15·25	1·284	49·50	34·40	12·80	3·30	Grey	59·10	41·00	52·80		Dull Black	Unchanged	16·80
16	Waitahuna, Otago	14·34		37·28	39·88	11·06	11·81	Light Buff	48·34	51·66	49·09	6·21	Brown	Slightly iri-descent	20·99
17	Tokomairiro, Otago	14·34	12·90	42·10	40·17	11·80	5·93	Light Grey	51·17	48.83	48·03		Dull Brown	Dull	23·40
18	Big Ben, Canterbury	13·96		45·00	41·10	12·00	1·90	Faint Buff	52·27	47·73	46·90	4·20	Black Brown	Do	12·00
	Shag Point, Otago	13·68	1·250 1·260	42 16	37·60	10·90	9·33	Chocolate	52·86	47·14	51·49	4·78	Dull Brownish Black	Do	12·30
20	Canterbury	13·35		36·06	49·34	11·40	3·20	Light Brown	42·22	57·78	39·20	1·60	Dull Black	Do	11·40
21	Mount Sumner, Coal Creek	10·91		39·60	39·20	8·80	12·40	Red & White	50·23	49·77	52·00	very much	Do	Do	8·80
22	Waikava, Otago	8·53		44·34	32·95	6·60	16·11	White	57·37	42·63	60·45	not much	Brown	Do	
23	Preservation Inlet, Otago, 3rd sample	5·50		54·58	25·62	4·20	11·20	Light Buff	68·05	31·95	65·78	very much	Tinge of Brown	Unchanged	8·60
24	Do Do 2nd ,,	4·94		66·43	22·53	4·40	2·24	Do	69·01	30·99	68·67	,,	Do	Do	8·86
25	Kawakawa, Bay of Islands, 2nd ,,	4·94	13·09	57·20	36·00	4·60	2·20	Light Red	61·37	38·63	59·40	4·90	Black	Dull, Sinters	4·60
26	Preservation Inlet, Otago 1st ,,	4·84	1·290	61·83	28·90	4·40	5·14	Light Buff	69·00	31·00	66.97	very much	Brownish Blk.	Dull	8·80
27	Kawa, Auckland	4·68	1·284	55·40	38·50	4·40	1·70	Light Red	59·00	41·00	57·10	5·10	Black	Dull, Sinters	4·40

TABLE I. COALS.—(*Continued.*)

No.	LOCALITY.	Percentage of Water.	Specific Gravity.	Percentage of				Color of Ash.	Percentage after deducting water and ash.		Coke.	Sulphur.	Color of Powder.	Nature of Coke.	Percentage of Water when first examined.	Action of Potash.
				Fixed Carbon.	Volatile Matter.	Water.	Ash.		Fixed Carbon.	Volatile Matter.						0·10
28	Pakawau, Nelson, 1 yd. seam	4·03	1.330	50·10	38·08	3·56	8·26	Light Red	56·82	43·18	58·36	1·04	Brownish black	Semi-metallic	3·56	
29	Agricultural Company, N.S.W.	4·02	1·280	55·10	36·40	3·70	4·80	Reddish Buff	60·28	39·72	59·90		Dark Brown	Shining, puffs up		
30	Do Block	3·97	1.283	60·10	30·50	3·60	5·80	Do	66·33	33·67	65·90	·78	Do	Do		
31	Wallsend Colliery	3·79	1·385	55·35	29·00	3·20	12.45	Grey	65·62	34·28	67·80	·28	Do	Do		
32	Newcastle, N.S.W., 2nd sample	3·45	1·380	55·36	31·59	3·00	10·05	Light Buff	63·67	36·33	65·41	1·60	Dull Black	Puffs up		
33	Do Do, 1st „	3·33	1·385	57·20	31·78	2·88	8·14	Do	64·28	35·72	65 34		Dark Brown	Do		
34	Waratah, N.S.W., Top of seam	3.04	1·293	58·40	33·60	2·80	5·20	Buff	63·48	36·52	63·60	·90	Do	Do		
35	Lambton Colliery, N.S.W.	2·85	1·267	54·50	36·40	2·60	6.50	Reddish	59·95	40·05	61·00	·80	Do	Do		
36	Waratah, N.S.W., Bottom of seam	2·80	1·287	55·35	36·85	2.60	5·40	Buff	60·05	39·95	60·75		Do	Do		
37	Buller River, Coalbrook Dale, Column	2·69	1 244	65·45	31·55	2·60	·40	Dark Buff	67·48	32·52	68 55	1·20	Do	Dull, cakes		
38	Grey River, Canterbury	2.18	1·333	62·37	29·44	1·99	6·20	Light Brown	67·94	32·06	68·57		Black	Cakes		
39	Do Do Iridescent	1·99	1·280	61·00	33·90	1·90	3·20	Grey	64·28	35·72	64·20		Dark Brown	Dull, puffs up		

TABLE I.—COALS.—(Continued.)

40	Pakawau, Nelson, 1 foot seam		1·89	1·409	38·00	35·20	1·60	25·20	Light Grey	51·91	48·09	63·20		Dark Brown	Dull Cake		
41	Buller River, Nelson		1·85		57·20	40·20	1·80	·80	Buff	57·20	40·20	58·00		Do	Puffs up		
42	Grey River, Nelson		1·72		55·40	37·20	1·60	5·80	White	59·83	40·17	61·20		Do	Do		
43	Malvern Hills, Canterbury		1·66		61·10	35·40	1·60	1·90	Do	63·32	36·68	63·00	1·80	Do	Dull		
44	Grey River, Nelson		1·60	1·300	54·11	33·19	1·40	11·30	Do	61·98	38·02	65·41	1·85	Brown	Puffs up		
45	Newcastle, N.S.W.		1·48		65·56	24·45	1·33	8·66	Do	72·83	27·17	74·22		Black	Do		
46	Buller River, Nelson		1·10	1·250	62·70	31·55	1·05	4·70	Do	66·52	33·48	67·40	1·85	Brownish black	Semi-metallic, cakes		
47	" " "		·83	1·260	58·74	35·97	·70	4·55	Do	62·02	37·98	63·29		Browif	Do		
	BRITISH COALS.																
	Northumberland		1·39	1·276	64·63	31·95	1·35	2·07				66·70	·74		Cakes, swells		
	Nottinghamshire		3.78		59·28	33·32	3·50	3·90	Faint Pink			63·18	·92				
	Wolverhampton, 10 yd. seam		12.88	1·288	56·18	31·50	11·29	1·03				57·21	·39		Puffs up		
	St. Helen's, Lancashire				60·33	31·27	3·23	5·17				65·50	·90		Cakes slightly		
	AMERICAN & OTHER COALS.																
	Labuan				56·15	34·57	7·56	1·72	Orange	61·89	38·11	57·87		Brown	Dull		
	Valparaiso				62·15	32·16	4·73	·96	Deep Red	65·90	34·10	63·11		Nearly Black			
	Vancouver				53·31	34·84	3·35	8·50	Light Grey	60·46	39·54	61·81		Dark Brown	Semi-metallic		

TABLE II.B.—*The following Table, constructed from the Analyses of* PROFESSOR MURRAY THOMSON, *Glasgow, is extracted from a Memoir by* DR. LAUDER LINDSAY, F.R.S.E., *on the Tertiary Brown Coals of Otago, in the Transactions of the Royal Society of Edinburgh.—Vol. XXIV., p.* 174.—*Feb.*, 1865.

LOCALITY.	PHYSICAL CHARACTERS OF COAL: SPECIMEN ANALYSED.	QUANTITY * PER TON.						PERCENTAGE.*			
		Coke.	Carbon in Coke.	Ash.	Volatile Matter.	Gas.	Oil.	Coke.	Carbon in Coke.	Volatile Matter.	Ash.
	I.—TERTIARY COALS OF OTAGO.	lbs.	lbs.	lbs.	lbs.	c. ft.	gls.				
I.—SADDLE HILL COLLIERY, on the property of Mr. Jaffrey, of Saddle Hill Park, about 10 miles southward from DUNEDIN, on the Great South or Invercargill Road.	1. From Main Adit: *Common Brown Coal.*—Brown; compact; massive; earthy; comparatively heavy;† brittle; *lustre* dull; *fracture* uneven; no vegetable structure apparent to naked eye; cracks on exposure as if baked, apparently from desiccation† and shrinkage; subsequently splinters into fragments or "small"	1021	659	362	1217	3175	..	45	29	54	16
	2. *Brown Coal.*—Blackish-brown; contains occasional *quartz* pebbles or grains; physical characters otherwise as in No. 1	972	887	85	1267	2954	17·	43	39	56	3
	3. From Roof of Main Adit: Transition state between *Brown Coal* and *Lignite.*—Obscurely fibrous or ligneous; laminated; associated with arenaceous shales	1262	681	586	977	3024	7·4	56	30	48	26
	4. *Lignite.*—Consists of, or contains, much vegetable débris; very friable; bears a close resemblance, save in color, to the *mineral charcoal* of the Scotch coal measures	1046	964	82	1194	3175	15·5	46	43	53	3
	Mean of four foregoing classes of Coal, which include *Brown Coal*, *Lignite*, and their transition states	1075	797	278	1163	3082	13·3	47	35	51	12
	5. From Roof of Main Adit: *Carbonaceous Shale.*—‡ Largely intermixed with arenaceous clays; very impure; not used as fuel	1099	733	366	1140	1889	...	48	32	50	16

TABLE II.B. BROWN COALS.—(*Continued*).

II.—SADDLE HILL: M'Coll's Creek, on its seaward base, near the coast, and about 10 miles southward of Dunedin.	6. *Brown Coal.*—Laminated; earthy; ochrey; friable; of light specific gravity; resembles, more than do most of the Otago Tertiary Coals, the *Brown Coals of Bohemia*	946	632	309	1296	3951	...	42	28	53	13
III.—ABBOT'S CREEK,§ on the Kaikorai stream, Chain Hills, Green Island, about six miles southward from Dunedin, on the Great South Road.	7. Transition state between Brown Coal, *Lignite*, and *Jet*, partaking of the lithological characters of all. Black; texture fibrous, partly woody; of light specific gravity: contains occasional *quartz* pebbles and *iron pyrites*; associated with *pyritous shales*, which yield on decomposition with water considerable quantities of *sulphate of iron.*	1068	787	331	1170	3024	...	47	32	52	14
IV.—MOUTH OF THE CLUTHA: Kaitangata Coal-field, Lewis' Colliery, Coast Cliffs, south of Coal Point, about 60 miles southward of Dunedin.	8. Transition state between *Lignites*, *Brown Coal*, and *Pitch Coal.*—Black; compact; *texture* sub-fibrous; *lustre* dull; fracture sub-conchoidal; of light specific gravity; graduates into a *Pitch Coal*, resembling in external character the *Scotch Cannels*, or the Mesozoic coals of Nelson and Canterbury	861	787	78	1378	3250	...	38	35	61	3
	Mean of the last three groups of specimens, which include *Brown Coals* and *Pitch Coals*, and their transitions into Lignite and Jet	957	718	235	1281	3401	...	42	31	55	10
	Mean of seven varities of the Otago Tertiary Coals, including the transition between *Jet* and *Pitch Coals*	1016	758	257	1222	3241	...	44	33	52	11
	ABSTRACT.										
	Maximum	1262	964	586	1378	3931	17·0	56	48	61	26
	Minimum	861	632	78	977	2954	7·4	38	28	48	3
	Average	1016	758	257	1222	3241	13·8	44	33	52	11
	II.—TERTIARY COALS OF NELSON.										
V.—ENNERGLYN, up the Waimea Valley, on a hill about four miles south of the town of NELSON; Jenkins' Colliery.	9. *Pitch Coal*, having the external characters of the "*Glanz Kohle*" of the Germans, and of the English "Newcastle." Black; *lustre* vitreous or splendent; *fracture* conchoidal. Much used in the town of Nelson as a domestic coal; but not used for steam purposes, avowedly on account of its large proportion of ash	973	911	62	1266	4400	...	43	40	56	2

* In round numbers (without decimals).

† The Otago Brown Coals generally contain, when first extracted from their beds, from 20 to 30 per cent. of water, of which sometimes as much as one-half is given off in the process of natural desiccation.

‡ Among these Carbonaceous Sandy Shales I found *Lignite*, closely resembling the Icelandic "Surturbrand." It could only be distinguished from recent or fresh wood by its greater darkness, density, and weight. In other localities, *e.g.* near Coal Point, I have found the same form of Lignite, always in strata, *overlying* the Brown Coal Proper, and referable, I suspect, to the newer or upper Tertiaries.

§ In the immediate vicinity of the Fairfield, Shand's, and Walton Park Collieries, now in successful operation, and probably part of the bed on which these rocks were situated.

TABLE III.—BASALTIC AND ALLIED ROCKS.

No.	Name and Locality.	Specific Gravity.	Soluble in Acid.	Insoluble in Acid.	Nature and Amount of Soluble Substances.						Hardness.	Action of Glauber's Salt.	Color, &c.
					Alumina.	Oxide of iron, and sometimes Manganese.	Lime.	Magnesia.	Alkalies.	Water of constitution.			
1	Trachytic Porphyry, Portobello	2·259 2·469	3·04	96·96	Trace		Trace		1·91		6	No action	White
2	Quartzose Trachyte, Governor's Bay, Lyttelton	2·309	4·70	95·30		1·21	1·09	Trace	Trace	1·80	5·5	Do	Black & White
3	Trachytic Porphyry, Portobello bay, Otago	2·533	5·86	94·14	3·16	·69	·54	do	·82	1·10	6	Do	Nearly White
4	Do. do Canterbury	2·329 to 2·402	9·80	90·20	3·26	1·80	·98		1·56	1·20	6	Do	Dirty Green
5	Do. do do	2·298	11·40	88·60	6·20		·80	·61	2·39	1·40	5·5	Slight	Rusty Color
6	Spheroidal Clinkstone, Bell Hill, Otago	2·320 2·621	17·55	82·45	2·08	6·61	1·51	Trace	·99	1·04	6	No action	Bluish Grey, carbonic acid, 3·94
7	Vesicular Basalt, Auckland...............		18·80	81·20	13·80	Trace	·62	3·01	·77	·60	4·5	Slight	Dark Grey
8	Tuffa, Anderson's Bay, Otago		19 49	80·51	7·67	5·94	Trace	·44	1·49	3·95	4	Much affected	Light Grey
9	Trachyte, Creightonvale, Canterbury...		23·79	76·21	7 20	9·26	2·60		2·87	·66	6	No action	Dull Lead Grey
10	Basaltic Conglomerate, Port Chalmers, Otago	2.558	29·07	70·93	3·13	9·51	6·04	Trace	2 45	·68	4·5	Slight	Grey, carbonic acid, 3·75

TABLE IV.—BASALTIC ROCKS.—ULTIMATE CONSTITUENTS.

	Name and Locality.	Sp. Gr.	Soluble in Acid.	Silica.	Aluminuna.	Iron Oxides.	Lime.	Magnesia.	Alkalies.	Water of Constitution.	Color.
1	Trachytic Porphyry, Portobello	2·445	5·86	66·40	24·35	1·52	0·54	Trace	6·54	1·10	Grey.
2	Trachy-dolerite, Flagstaff Hill	2·519	11·46	59·32	21·06	5·93	7·36	0·20	5·57	1·20	Dark Greyish Green.
3	Clinkstone (spheroidal), Bell Hill	2·621	17·55	54·19	21·27	6·61	3·50	Trace	10.27	1·04	Light Grey.
4	Clinkstone (laminated), Blanket Bay	2·660	24·11	55·65	23·32	4·86	2·15	Trace	10·46	4·31	Light Green.
5	Vesicular Basalt, Kaikorai	2.589	32·71	42·74	5·61	23·17	5.31	7·47	10·74	3·00	Reddish Grey.
6	Porphyrytic Basalt, Pine Hill	2·859	33·79	48.05	20·45	12·12	8.87	Trace	5·05	2·05	Dark Blue Grey.
7	Dolerite, Kaikorai	2·875	41·79	40·51	20·71	12·09	10.35	5·11	9·33	1·90	Bluish Gray.

No. 3 contains 3·94 per cent. of Carbonic Acid.

TABLE V.—LIMESTONES IN THE ORDER OF THEIR PURITY.

No.	Character.	Locality.	Specific Gravity	Carbonate of Lime.	Carbonate of Magnesia.	Soluble Silica	Oxide of Iron	Alumina.	Insoluble matter.	Color.	Remarks.
1	Crystalline	Southland		98·80	Trace	Trace		1·20	1·20	White	
2	Do.	Do.		97·90	„	„	Trace	·60	1·50	Bluish	
3	Sub-Crystalline	Canterbury		97·01	1·19	„	·60		1·20	„	
4	Fossiliferous	Oamaru, Otago		95·95	2·17	0·6	Trace	·45	·74	Light Yellow	
5	Compact	Wairoa, Auckland		95·47	Trace	Not estimated	„	2·29	2·24	Light Buff	Hygroscopic water, ·80
6	Lithographic	Oamaru, Otago	2·667	95·18	1·29	„	·47	1·20	2·33	Yellow	Trace of Sulphate.
7	Travertine	Do Otago	•	95·04	2·56	Trace		·60	1·80	Grey & Yellow	
8	Compact	Nelson		94·88	·52	Not estimated	Trace	1·20	3·40	Bluish Grey	
9	Veined	Auckland		94·37	·23	„	1·60	Trace	3·80	Grey	
10	Granular	Oamaru		93·42	2·58	·50	Trace	1·01	2·45	„	
11	Do.	Southland		92·20	Trace	Not estimated	2·20	Trace	5·60	Fawn	
12	Shelly	Napier		91·80	·60	„	1·40	„	6·20	Grey	
13	Compact	Wakatip Lake, Otago	2·702	91·60	2·94	·20	·84	„	4·42	„	
14	Do.	Oamaru, Otago	2·698	90·99	2·16	3·10	·62	„	2·90	Bluish	Loss, ·23
15	Shelly	Southland		90·80	Trace	Not estimated	Not estimated	2·29	6·89	Grey	
16	Granular	Oamaru, Otago		90·14		·46	·54	1·54	7·14	White	Loss, ·18, tr. chlorides.
17	Conglomerate	Do. Otago	2·583	87·08	Trace	Not estimated	·79	2·85	8·58	Nearly White	Loss, ·78 „
18	Compact	Portobello, do.		86·80	„	„	Trace	·80	12·40	Dark	
19	Do.	Do. Otago		81·10	1·70	„	·80	Trace	16·60	Yellowish	
20	Shelly	Napier		81·10	·90	„	1·80	„	16·20	Grey	

TABLE VI.—SELECTED ANALYSES OF FREESTONE TO ILLUSTRATE THEIR GENERAL COMPOSITION.

	Name.	Specific gravity, or ozs. in cube foot.	Porosity 0—10.	Essential Constituents.			Impurities.			Water of Constitution, and Hygroscopic.	Color, &c.
				True Sand.	Carbonates—Lime and Magnesia.	Insoluble Clay.	Soluble Clay.	Oxide of Iron.	Alkaline Chlorides.		
	A.—Silicious Sandstones.										
1	Hobart Town	2560	1	86.7	0·0	7·1	4·2	Traces	1.0	1·81	Greyish White
2	Moeraki	2490	5	82 5	0·0	9·0	3·5	2·0	0·56	2·99	Rusty Brown
3	Waikava	2677	2	80·1	5·8	0·0	7·4	4·6	0·0	2·51	Dark Greenish Grey
4	Arden Bay	2445	4	70·8	0·0	25·4	0·0	1·8	1·3	2·28	Reddish White
	B.—Clay-stones.										
5	Saddle Hill	2240	4	56·0	0·0	28·5	10·8	1·7	0·7	4 05	Buff Yellow
6	Moeraki	2425	8	52·7	0·0	41·5	1·8	Traces	1·0	4·14	Grey
7	Mount Pleasant	2376	3	37·8	0·0	41 8	14 9	2·6	0·4	4·80	Greenish Grey
	C.—Calcareous Sandstones.										
8	Kaikorai (a)	2170	6	21·0	42·1	25·9	3·4	1·7	0·0	5·9	Buff Yellow
9	Caversham	2200	4	24·4	53 0	17·6	1.5	1·4	0·2	2·0	Bluish Grey
10	Hawksbury	2597	3	25·0	51·7	17·9	3·6	0·8	Traces	1·9	Bluish Grey
11	Kaikorai (b)	2532	2	28·0	62 8	1·0	4·5	1·8	0·0	0·6	Greyish Yellow
12	Kaikorai ? (c)	2549	1	27·6	68·5	0·0	2·4	0·8	0·0	4·2	Greyish Yellow
13	Pleasant River	2307	1	29·5	64·1	0·0	1·2	0·8	0·0	0·0	Pure Grey

TABLE VII. (PART 1).—SILICIOUS FREESTONES.

Compiled to Illustrate their Relative Composition.

	LOCALITY.	Specific gravity, or ozs. in a cubic foot.	Porosity 0—10.	Soluble in acid.	Insoluble in acid.	Nature and amount of Substances soluble in acid.							Soluble Salts.	Action of Glauber's Salt.	Color.
						Soluble Silica.	Alumina.	Oxide of Iron.	Lime.	Magnesia.	Water of Constitution.	Alkalies.			
1	Hobart Town, Tasmania ...	2.710	1	3.02	96.98	trace	1.90	trace	20	trace	.78	trace			
2	Arden Bay, Upper Harbour, Otago........	2.445	4	3.72	96.28	trace	.99	.78	28	.29	.89	.77	1.00		light color.
3	Governor's Bay, Canterbury		1	4.05	95.95	trace	trace	2.20	45		.80	.60	.60		mottled yellow.
4	Moeraki, Otago	2.425	8	5.77	94.23	trace	1.77	trace	trace	trace	2.77	1.23	.99		light grey.
5	Hobart Town, Tasmania ...	2.560	1	6.31	93.69		4.23	trace	.34	.32	1.26	.16	.30		white.
6	Moeraki, Trotter's Creek, Otago........	2.490	5	8.44	91.56	trace	2.72	2.00	.56		2.99	.17	trace		rusty red.
7	Bay of Islands, Auckland ...		1	10.50	89.50	trace	4.74	trace	1.24	.63	.19	3.70			white.
8	Saddle Hill, Otago	2.240		15.48	84.52	6.08	4.84	1.68	trace	.53	.18	2.17			faint red.
9	Waikava, "	2.677	2	20.13	79.87	2.41	9.60	trace	1.98	2.26	2.51	not much			rusty red.
10	Mount Pleasant, Otago	2.376	3	20.18	79.82	7.75	7.21	2.60		trace	1.80	.72			greenish grey.

TABLE VII. (PART 2).—CALCAREOUS FREESTONES.

Compiled to Illustrate their relative Composition.

	LOCALITY.	Specific gravity, or ozs. per cubic foot.	Porosity 0—10.	Soluble in acid.	Insoluble matter.	Composition of part soluble in acid.						Soluble salts.	Action of Glauber's Salt.	Color.
						Soluble silica.	Alumina.	Iron oxide.	Carbonate of lime.	Carbonate of magnesia.	Water and loss.			
11	Dunedin, vicinity of, Otago	2.549	7	72.35	27.65	.72	1.79	.79	68.51	trace	.54			grey.
12	Canterbury	2.268		69.99	30.02	.80	2.60	trace	65.96	.63				light buff.
13	Oyster Point, Otago Harbor			69.98	30.01	1.00	3.00	trace	64.60	1.16	.22			dark grey.
14	Pleasant Fiver, Otago	2.307		70.46	29.53	.63	.60	.83	63.08	1.10	4.22			
15	Cornish Mt., Waikouaiti, Otago			68.60	31.40		2.83		65.77	trace				dark grey.
16	Waihemo, „			65.20	34.80		1.80	1.20	61.60	.28	.32			light yellow.
17	Kaikorai Valley, „			69.81	30.19	1.57	2.90	1.78	60.86	1.99	.71			dark grey.
18	Sibbald's Quarry, Caversham, Otago..	2.200		56.36	43.64		2.92		51.22	1.56	2.66			greenish grey.
19	Hawksbury, Otago			57.06	42.94	.70	2.94	.90	50.05	1.70	.77			dark grey.
20	Mt. Hacket basalt, Otago			47.80	52.20		5.20		41.20	trace	1.40			„
21	Kaikorai Quarry, „	2.170		53.20	46.80	3.40	1.75	trace	40.45	1.70	5.90			pale yellow.
22	Auckland			45.40	54.60		4.40		37.60	2.10	1.30			red and black.
23	Motupipi, Auckland			35.10	64.80		4.21		30.27	.72				light green.
24	Moeraki, Otago			32.20	67.80		trace	4.20	20.40	2.20	5.40			red and white.

TABLE VIII.—BLACK SANDS TABULATED IN THEIR ORDER OF RICHNESS IN IRON.

	Character.	Locality.	Magnetic Iron.	Titanic Iron.	Hæmatite.	Silicious matter.	Iron.	Remarks.
1	Titaniferous Iron Sand	Stewart's Island	71·50	25·97		2·53	70·14	Contains 8·21 titanic acid; non-auriferous; sp. gr. 5·8832—5·882
2	Magnetic Iron Sand ..	Dunstan Diggings, Otago ..	82·77	9·73		7·02	65·96	Contains ·48 of gold, sp. gr. 4·960.
3	Hematite Sand	Tuapeka Diggings „ ..	2·24		92·88	4·88	63·87	Auriferous.
4	Magnetic Iron Sand ..	Musgrave's Run „ ..	86·06		10·51	3·43	58·56	Auriferous.
5	Magnetic and Titaniferous Iron Sand..	Taranaki	71·00	8·00		21·00	56·00	Non-auriferous.
6	Ditto	Nelson, No. 32, on sample..	75·00			25·00	55·00	Silicious matters are principally garnets; is non-auriferous.
7	Titaniferous Iron Sand	Hooper's Inlet, Otago ..	20·00	74·28 With Hæmatite		5·72	53·00	Non-auriferous.
8	Magnetic Iron Sand ..	Arrow River, Wakatip, Otago	80·00		7·61	12·39	52·90	Auriferous.
9	Titaniferous Iron Sand	Saddle Hill, Otago	58·38	25·66		15·96	52·96	Contains 9·40 of titanic acid; non-auriferous.

APPENDIX B.

PURE AND CROSS-BRED WOOLS.

THE great importance of exact information as to the effect of Cross Breeding in Sheep in New Zealand has determined the Editor to reprint the following particulars, from the Official Catalogue, of the samples of wool exhibited (1623-30) by MR. A. LUDLAM,* Hutt Valley, Wellington.†

1623 Case 1.—Samples of Wool, *PURE SOUTHDOWN*—

1. Pure bred Southdown Ram, age 5 years; imported from England, 2-tooth; shorn November, 1864, previous shearing, December, 1863; unwashed, weight of fleece 6lbs, staple 3 inches, price in London, 1864, 1s. 10d., unwashed.

2. Pure bred Southdown Ram, bred in Nelson from imports from Mr. Jonas Webb; 5 years old; shorn November, 1864, previous shearing, December, 1863; unwashed; weight of fleece 6lbs., staple 3 inches, price in London, 1864, 1s. 10d., unwashed.

3. Pure bred Southdown Ewe, from pure bred Ewe and Ram No. 1; shorn November, 1864; age 2 years and three months; previous shearing, December 7, 1863; unwashed; never diseased or dipped; weight of fleece, 7lbs., staple, 2½ inches, price in London in 1864, 1s. 10d. per lb., unwashed.

4. Pure bred Southdown Lamb, from imported Ewe and Ram No. 1; age 14 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece, 6½lbs., staple 2½ inches, price in London in 1864, 1s. 10d. per lb., unwashed.

5. Second Cross—Ram Lamb, from Ram No. 1, and a Ewe of first cross; age 14 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 7½lbs., staple 4 inches, price in London, 1864, 1s. 10d., unwashed.

6. Second Cross—Pure bred Southdown Ram and Ewe of first cross; 14 months old Ram Lamb; shorn November, 1864; unwashed; weight of fleece 7½lbs., staple 3½ inches, price in London in 1864, 1s. 10d. per lb., unwashed.

7. Second Cross—Ram Lamb, age 14 months, by Ram No. 1, from Ewe of first cross; shorn November, 1864; unwashed; never dipped or diseased; weight of fleece 7½ lbs., staple 4½ inches, price in London, 1864, 1s. 10d. per lb., unwashed.

---

* Mr. Ludlam has been awarded a Silver Medal by the Commissioners.—ED.

† It is a source of regret that the particulars given by other Exhibitors from Wellington—George Hunter (1658), Major H. J. Coote (1661), E. and C. Pharazyn (1663), and J. Varnham—not being in the Catalogue, are not obtainable in time to allow them to be added.—ED.

8. Second Cross—Ram Lamb, age 14 months; by pure bred Southdown Ram No. 1, and a Ewe of first cross; shorn November, 1864; unwashed; weight of fleece 7lbs., staple 4 inches, price in London, 1864, 1s. 10d., unwashed.

9. Pure bred Southdown Ewe, from imported Ewe, by Ram No. 1; age 2 years and 3 months; shorn December, 1864, previous shearing December, 1863; unwashed; weight of fleece 4lbs., staple 3 inches, price in London in 1864, 1s. 10d. per lb., unwashed.

10. Pure bred Southdown Ewe, age 5 years; imported from England 2-tooth over; shorn December, 1864, previous shearing December, 1863; unwashed; weight of fleece 4½lbs., staple 3 inches, price in London, 1864, 1s. 10d. per lb., unwashed.

1624 Case 2.—Samples of Wool, *SOUTHDOWN CROSSES*—

11. First Cross—Between a pure bred Southdown Ram, No. 2, and a Ewe of the second cross of Romney Marsh and Merino; Ewe, age 2 years 3 months; shorn December, 1864, previous shearing December, 1863; unwashed; weight of fleece 6½lbs., staple 3½ inches, price in London in 1864, 1s. 10d. per lb., unwashed.

12. First Cross—Between pure bred Southdown Ram and a Ewe of second cross of Romney Marsh and Merino; Ewe, aged 3 years 3 months; shorn December, 1864; previous shearing, December, 1863; weight of fleece 5½lbs.; staple 4 inches, price in London in 1864, 1s. 10d., unwashed.

13. First Cross—Between pure bred Southdown Ram and Ewe of second cross between Romney Marsh and Merino. Ewe, aged 2 years 3 months; shorn December, 1864, previous shearing December, 1863; unwashed; never dipped or diseased; weight of fleece 7lbs., staple 3½ inches, price in London in 1864, 1s. 10d., unwashed.

14. First Cross—Between pure bred Southdown Ram and Ewe of second cross of Romney Marsh and Merino. Ewe, 2 years 3 months old; shorn December, 1864, previous shearing December, 1863; unwashed; never diseased or dipped, weight of fleece 7lbs., staple 4 inches, price in London, 1864, 1s. 10d., unwashed.

15. Second Cross—Between pure bred Southdown Ram and a Ewe of first cross. Ewe hogget; age 14 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 6lbs, staple 5 inches, price in London, 1864, 1s. 10d., unwashed.

16. Second Cross—Between pure bred Southdown Ram, and Ewe of first cross. Ewe hogget, 14 months old; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 6½lbs., staple 5 inches, price in London, 1864, 1s. 10d., unwashed.

17. Second Cross—Between pure bred Southdown Ram and Ewe of first cross. Ewe, aged 2 years 3 months; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 6½lbs., staple 3½ inches, price in London, 1864, 1s. 10d., unwashed.

18. Second Cross—Between pure bred Southdown Ram and Ewe of first cross. Ewe hogget, age 14 months; never washed, dipped, or diseased; weight of fleece 6lbs., staple 4 inches, price in London in 1864, 1s. 10d., unwashed.

19. Second Cross—Between pure bred Southdown Ram, No. 1, and Ewe of first cross. Wether, 14 months old; shorn November, 1864; never washed, dipped, or diseased; weight of fleece 6lbs., staple 5½ inches, price in London in 1864, 1s. 10d. per lb., unwashed.

20. Second Cross—Between pure bred Southdown Ram, No. 1, and Ewe of first cross. Wether, age 14 months; shorn November, 1864; unwashed; never dipped or diseased; weight of fleece 6lbs., staple 3 inches, price in London, 1864, 1s. 10d., unwashed.

1625 Case 3.—Samples of Wool, *PURE ROMNEY MARSH*—

1. Pure bred Romney Marsh Ram, full mouthed; imported from England, October, 1861, age 2 years and 3 months; shorn November, 1864, previous shearing, November, 1863; unwashed; never diseased, not dipped since arrival; weight of fleece 14lbs., length of staple 7½ inches, average price at London Wool Sales, 1864, 1s. 10½ per lb., unwashed.

2. Pure bred Romney Marsh Ram, full mouthed; imported from England, October, 1861, 2 years and 3 months old; shorn November, 1864, previous shearing, November, 1863; unwashed; never diseased, not dipped since arrival; weight of fleece 12lbs., staple 7 inches, price in London in 1864, 1s. 10½d. per lb., unwashed.

3. Pure Romney Marsh Ram, 2 years 3 months; imported December, 1863, 1 year 3 months old; shorn November, 1864, previous shearing January, 1864; unwashed; never diseased, not dipped since arrival; weight of fleece 10lbs., staple 7 inches.

4. Pure bred Romney Marsh Ram, 2 years and 3 months old; imported from England December, 1864, age 1 year and 3 months; shorn November, 1864, previous shearing January, 1864; unwashed; never diseased, not dipped since arrival; weight of fleece, 8½lbs., staple 6 inches.

1626 Case 4.—Samples of Wool, *PURE ROMNEY MARSH*—

5. Pure bred Romney Marsh Ram, full-mouthed; bred at Hutt Valley, near Wellington, from imported Ram and Ewe; shorn November, 1863, previous shearing, November, 1862; unwashed; never diseased or dipped; weight of fleece 13lbs., staple 8 inches, price in London in 1864, 1s. 10½d., per lb., unwashed.

5*a*. Pure bred Romney Marsh Ram, 2 years and 3 months; from imported Ram No 1 and imported Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 13½lbs., staple 7 inches, price in London in 1864, 1s. 10½d. per lb., unwashed.

6. Pure bred Romney Marsh Ram, 1 year and 3 months; from imported Ram and Ewe; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 11½lbs., staple 7 inches, price in London in 1864, 1s. 10½d. per lb., unwashed.

7. Pure bred Romney Marsh Ram, age 1 year 3 months; from imported Ewe by Ram No. 1; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 11lbs., staple 8 inches, price in London in 1864, 1s. 10½d. per lb., unwashed.

8. Pure bred Romney Marsh Ram, age 14 months; from imported Ewe and Ram No. 2; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece, 10lbs., staple 6½ inches, price in London, 1864, 1s. 10½d. per lb., unwashed.

9. Pure bred Romney Marsh Ram Lamb, age 12 months, from imported Ewe and Ram No. 2; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 6lbs., staple 5 inches, price in London in 1864, 1s. 10½d. per lb., unwashed.

10. Pure bred Romney Marsh Ewe, 2 years 3 months, from imported Ewe by Ram No. 1; shorn November, 1864, previous shearing November, 1863; un-

washed; never diseased or dipped; weight of fleece 8½lbs., staple 7 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

11. Pure bred Romney Marsh Ewe, age 3 years 3 months, from imported Ewe and Ram No. 5; shorn November, 1864, previous shearing November, 1863, unwashed; never diseased or dipped; weight of fleece 8lbs., staple 6 inches, price in London, 1864, 1s. 10½d. per lb., unwashed.

1627 Case 5.—Samples of Wool, *ROMNEY MARSH AND CROSSES*—

12. Pure bred Romney Marsh Ewe, age 3 years 3 months, from imported Ewe by Ram No. 5; shorn November, 1864, previous shearing November. 1863; unwashed; never diseased or dipped; weight of fleece 8lbs., staple 6 inches, price in London, 1864, 1s. 10½d. per lb., unwashed.

13. Pure bred Romney Marsh Ewe, age 2 years 3 months, from imported Ewe, by Ram No. 1; shorn November, 1864, previous shearing November, 1863; weight of fleece 8lbs., staple 6½ inches, price in London in 1864, 1s. 10½d. per lb., unwashed.

14. Pure bred Romney Marsh Ewe hogget, age 1 year 2 months, from imported Ewe, by Ram No. 1; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 8½lbs., staple 7 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

15. Pure bred Romney Marsh Ewe hogget, age 14 months, from imported Ewe and Ram No. 1; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 9lbs, staple 6 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

16. First Cross—Between pure bred Romney Marsh Ram and pure Merino Ewe; 5 years old, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 6½lbs., staple 5 inches, price in London, 1864, 1s. 10½d. per lb., unwashed.

17. First Cross—Between pure bred Romney Marsh Ram and pure bred Merino Ewe; 5 years old, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never dipped or diseased; weight of fleece, 5½lbs., staple 5 inches, price in London in 1864, 1s. 10½d. per lb., unwashed.

18. First Cross—Between pure bred Romney Marsh Ram and pure bred Merino Ewe; age 5 years, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 5½lbs, staple 5 inches, price in London, 1864, 1s. 10½d., per lb., unwashed.

19. First Cross—Between pure bred Romney Marsh Ram and pure Merino Ewe; age 5 years, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 6lbs., staple 4½ inches, price in London in 1864, 1s. 10½d, per lb., unwashed.

1628 Case 6.—Samples of Wool, *ROMNEY MARSH AND CROSSES*—

20. Second Cross—Between Ewe of the first cross and pure bred Romney Marsh Ram; age 3 years 3 months, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 9lbs., staple 6½ inches, price in London in 1864, 1s. 10½d. per lb., unwashed.

21. Second Cross—Between Ewe of the first cross and pure bred Romney Marsh Ram; age 2 years 3 months, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 9lbs., staple 7 inches, price in London in 1864, 1s. 11½d. per lb., unwashed.

22. Second Cross—Between Ewe of first cross and pure bred Romney

Marsh Ram; age 3 years 3 months, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece, 9lbs., staple 6 inches, price in London in 1864, 1s. 10½d. per lb., unwashed.

23. Second Cross—Between Ewe of first cross and pure bred Romney Marsh Ram; age 2 years 3 months, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 8lbs., staple 5 inches, price in London in 1864, 1s. 11d., unwashed.

24. Third Cross—Between Ewe of second cross and pure bred Romney Marsh Ram; 2 years 3 months, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 13lbs., staple 4 inches, price in London in 1864, 1s. 11d. per lb. unwashed.

25. Third Cross—Between Ewe of second cross and pure bred Romney Marsh Ram; age 2 years 3 months, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 8lbs. staple 6 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

26. Third Cross—Between Ewe of second cross and pure bred Romney Marsh Ram; age 2 years 3 months, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 10lbs. staple 5 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

27. Third Cross—Between Ewe of second cross and pure bred Romney Marsh Ram; age 2 years 3 months, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight of fleece 9lbs., staple 6 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

1629 Case 7.—Samples of Wool, *ROMNEY MARSH AND CROSSES*—

28. Third Cross—Between Ewe of second cross and pure bred Romney Marsh Ram; age 2 years 3 months, Ewe; shorn November, 1864, previous shearing November, 1863; unwashed; never diseased or dipped; weight 7½lbs., staple 6 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

29. Third Cross—Ewe Hogget, from pure bred Romney Marsh Ram and Ewe of second cross; age 15 months; unwashed; never diseased or dipped; weight of fleece 8lbs., staple 7 inches, price in London in 1864, 1s. 11d per lb., ununwashed.

30. Third Cross—Ewe Hogget, from Ram No. 1 and Ewe of second cross; age 1 year 3 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece, 11lbs., staple 7½ inches, price in London in 1864, 1s. 11d. per lb., unwashed.

31. Third Cross—Ewe Hogget, from Ram No. 1 and a Ewe of second cross; age 1 year 3 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 9lbs., staple 5½ inches, price in London in 1864, 1s. 11d. per lb.

32. Third Cross—Ewe Hogget, from pure bred Romney Marsh Ram and Ewe of second cross; age 1 year 3 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 8½lbs., staple 6 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

33. Third Cross—Ewe Hogget, from a Ewe of second cross and Ram No. 2; age 1 year 3 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 10lbs., staple 7 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

34. Third Cross—Ewe Hogget, from Ram No. 2 and Ewe of second cross; age 1 year 3 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 9lbs., staple 7 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

35. Third Cross—Ewe Hogget, from Ram No. 2 and a Ewe of second cross; age 1 year 3 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 8½lbs., staple 7 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

1680 Case 8.—Samples of Wool, *ROMNEY MARSH AND CROSSES*—

36. Third Cross—Wether, from Ewe of second cross and Ram No. 2; age 1 year 3 months; shorn November, 1864; unwashed; never dipped or diseased; weight of fleece 8½lbs; staple 7 inches, price in London in 1864, 1s 11d. per lb., unwashed.

37. Third Cross—Ewe Hogget, from Ram No. 5 and Ewe of second cross; age 1 year 3 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 9lbs., staple 7 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

38. Third Cross—Ewe Hogget, from Ram No. 5 and Ewe of second cross; age 1 year 3 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 9lbs, staple 7 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

39. Third Cross—Ewe Hogget, from Ram No. 5 and a Ewe of second cross; age 1 year 3 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 9½lbs., staple 6 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

40. Third Cross—Ewe Hogget, from Ram No. 5 and a Ewe of second cross; age 1 year 3 months; shorn November, 1864; unwashed; never diseased or dipped; weight of fleece 7½lbs., staple 6 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

41. Ewe Hogget, the product of a half-bred Ewe and Ram from pure Romney Marsh Ram and Merino Ewe; 17 months old; shorn middle of January, 1864; unwashed; never diseased or dipped; weight of fleece 11½lbs., staple 7 inches, price in London in 1864, as hogget, unwashed, 1s. 11d. per lb. ☞ Particular attention is called to this sample, as shewing the results of breeding from cross-bred sheep. The weight of the fleece is more than usual, from the fact that the animal was not shorn until January, or six weeks after the usual time.

42. Ewe Hogget, the product of a half-bred Ewe and Ram, from pure Romney Marsh Ram and Merino Ewe; 17 months old; shorn in January, 1864; unwashed; never diseased or dipped; weight of fleece 14lbs., staple 9 inches, price in London in 1864, 1s. 11d. per lb., unwashed. ☞ Particular attention is called to this sample, as shewing the result of breeding from cross bred sheep. The weight of the fleece is more than usual, from the fact that the animal was not shorn until January, or six weeks after the usual time.

43. Ewe Hogget, the product of half-bred Ewe and Ram, from pure Romney Marsh Ram and Merino Ewe; 17 months old; shorn January, 1864; unwashed; never diseased or dipped; weight of fleece 9½lbs., staple 8 inches, price in London in 1864, 1s. 11d. per lb., unwashed.

APPENDIX C.

RESULTS OF A SERIES OF

EXPERIMENTS ON THE STRENGTH

OF

NEW ZEALAND & OTHER COLONIAL WOODS;

CONDUCTED, AT DUNEDIN, FOR THE COMMISSIONERS OF THE NEW ZEALAND EXHIBITION, BY

JAMES MELVILLE BALFOUR, C.E.,

Provincial Marine Engineer of Otago, Chairman of the Associate Committee of Consulting Engineers.

IN entering on their arduous duties the Commissioners justly considered it of the utmost importance to investigate the properties of the materials used in construction in the Colony, with regard to which, up to the present time, comparatively little information has been collected; the estimation in which the different kinds are held being to a great extent local, and founded much more on opinion, (perhaps sometimes on prejudice), than on any scientific and exact knowledge of their qualities. In prosecution of this important object, the Commissioners particularly called for samples of all Colonial Woods for testing, and it is greatly to be regretted that that call was not more fully responded to, and that the information furnished along with the specimens sent was not more full and precise; at the same time, many gentlemen have taken great pains in collecting samples, and it is hoped that the results in the following Tables will be found useful, though not so complete and exhaustive as was to be desired. The principal exhibitors of New Zealand Timbers were C. and J. Ring (28*), and R. B. Shalders (32), Auckland; C. Webber, C.E., Provincial Engi-

* Catalogue number.—ED.

neer (128), Hawke's Bay; Hon. W. Petre (206), Wellington, who sent a valuable collection of no less than fifteen different kinds of timber; G. Holmes, C.E. (415, 416, 417), Canterbury; and J. W. F. Robinson (546) and A. H. Ross (547) Otago.

Tasmanian woods were well represented, the principal exhibitors being J. C. Boyd (2823), Port Arthur; and Dr. Crowther (2825), Hobart Town; and the value of these samples was greatly increased by the full information, as to the dimensions, durability, and uses of the different timbers, which was sent with them. From New South Wales, Professor Smith, Sydney University, sent a valuable collection of small samples for testing purposes, the importance of which is greatly enhanced by the information which he kindly procured, as to the estimation in which the different varieties are held in that Colony, &c., and by information as to the Botanical and Native names of the woods from the pen of Sir William Macarthur, Chief Commissioner for the Colony of New South Wales at the Paris Exhibition of 1855, all of which has been incorporated in the General Table (No. 1).

The New South Wales woods possess a further value, from the fact that they have all been tested at Sydney (1860-61), by E. W. Ward, Esq., Deputy Master of the Mint, and a number of them also at Paris, in 1855, by Captain Fowke, R.E.; so that they form, as it were, a connecting link between the New Zealand experiments and those which have been conducted elsewhere.

With regard to the distinctive names of the Eucalypti, Sir W. Macarthur remarks:—"I cannot venture to give the Botanical specific name to any of the Family. It is acknowledged to be in great confusion, scientifically speaking, and requires a first-rate hand, with opportunities probably for full investigation on the spot, to put in order and describe." This statement may be illustrated by the fact that the Australian Lloyd's Regulations give *Eucalyptus mahogani* as the scientific name of the Jarrah, or Swan River Mahogany, a variety believed to be confined to the West Coast of Australia, while the printed account of experiments on the Timbers of New South Wales and Queensland (1861) gives the same name to a Sydney wood which is probably a distinct species.

Similar difficulties beset the classification of New Zealand woods; though in this country the botanical names are probably better known, there being no family with such extended ramifications as the Eucalypti, but the Native and Settlers' names appear to be different in different districts, and in many instances these only are given with the specimens exhibited. I have endeavored to arrange the whole properly, but must intreat the indulgence of the reader for any unavoidable lapses or mistakes.

In issuing their programme, the Exhibition Commissioners being desirous to continue the series of numerous and exact experiments conducted at Paris by Captain

Fowke, called for samples of the appropriate size—namely, two inches square, and not less than fourteen inches long, so that the Associate Committee of Consulting Engineers were tied down to these dimensions, though longer samples, if not larger scantlings, would certainly have been preferable.

Captain Fowke's experiments embraced:—1, Specific Gravity; 2, Ultimate Strength; 3, Crushing Strain in line of fibre; 4, Crushing Strain transverse to fibre; 5, Elasticity. The last, however, somewhat imperfectly, as the deflections on a two-inch square sample, loaded at the centre, and with bearings only twelve inches apart, are necessarily very small.

In addition to the above, I suggested that the Tensile Strain in line of and transverse to fibre, (the latter a new experiment, and one that promised to give valuable information as to the lateral cohesion of the fibres,) should also be ascertained, and, in addition, that subsidiary experiments on small samples, fixed at one end and loaded at the other, should also be made, as tending to give a more delicate measure of the elasticity of the various woods, as well as to corroborate the values of S obtained from the larger samples.

These suggestions having been appproved of, sketches were made of a hydrostatic press working vertically, and so arranged that the pressure exerted should be at all times indicated on a large dial, whose indications could be checked from day to day by the application of actual weights to the plunger of the press, so as to eliminate the disturbing influences of friction; and subsidiary parts were also designed to enable it to be employed for crushing cubes of wood and stone, for testing the tensile strength of timber, &c. Sketches were also prepared for a small testing machine for one-inch square samples of timber, fixed at one end and loaded at a point twelve inches from the point of support, the force applied being measured by a spring steelyard, and proper arrangements being made for measuring the flexibility of the specimens, and for keeping the one set of observations entirely independent of the other.

The smaller machine was very satisfactorily completed by the Contractors, Messrs. Wilson Brothers, Dunedin; but the Contractors for the hydrostatic machine, unfortunately, never succeeded in making it work properly, and after long and most vexatious delays abandoned it altogether, to the great annoyance of the Commisioners, who were thereby compelled very materially to curtail their plans; in consequence, all experiments on the crushing strength of stones, and a large proportion of the intended experiments on woods were abandoned, and the results in the Tables were ascertained by the small machine from samples of the unsatisfactorily small dimensions of 1 inch square and 12 inches long. This is much to be regretted, as there can be no doubt that experiments on a larger scale would have been much more to be depended

on in all cases; while some cross-grained varieties of wood, such as Curled Blue Gum (53, in the detailed Table I), Waved Kauri (26, in Table I.), and Red Pine (32, in Table I.), probably give absolutely delusive results when tested on so small a scale, as the "wave" or curl of the fibre, which would be to a great extent eliminated in larger samples, runs entirely across these small specimens, which were all found to break nearly square across. At the same time, the arrangements of the small testing machine were very delicate, the indications of the spring were frequently tested by actual weights, and the applied strain could be measured to the nearest pound, and the resulting deflection to the 50th of an inch, so that it is believed that all ordinary straight-grained varieties of wood are fairly represented in the Tables, while there can be no doubt that the different results are comparable *inter se;* and, as already pointed out, the New South Wales woods, having been before experimented upon elsewhere, give as it were a scale by which the results at Dunedin may be compared with others.

On instituting such a comparison, it will be observed that the Paris and New Zealand experiments agree very well, making due allowance for the fact that the woods in most cases came from different districts; in one case the Sydney results are higher than those obtained in New Zealand, (Spotted Gum); in another, (Blue Gum), the mean of all the experiments at Dunedin is not far above the Sydney results, but in all the others the value of S as found at Sydney are considerably below those found at Dunedin, in several cases by about one-third of the higher result; at the same time the values of E agree much more nearly, and in a number of instances while the Sydney experiments make the breaking weight considerably under the results ascertained at Dunedin, they make the weight which is carried with unimpaired elasticity absolutely higher. When the results of experiments on New Zealand woods are similarly compared, it will be found that in nearly every instance in which the Sydney results make S lower, they at the same time make E higher, the weights carried with an impaired elasticity being also higher. In endeavouring to account for these somewhat remarkable results, I was led to compare, in all cases, the breaking weight with the weight carried with uninjured elasticity, and eventually to introduce such comparison into the Tables in a fractional form $\left(\text{Col. } \frac{W'}{S}\right)$; as it seems, if not to give a complete solution to the discrepancy, at least to show that it is a matter of little practical consequence. Thus it will be observed, that, in the Sydney experiments, Towai carried with unimpaired elasticity 0.982 of its breaking weight, Matai 0.942, Tawa 0.909, Taraiu 0.895, and Totara 0.826; whereas in the New Zealand experiments those fractions are very much smaller, the highest fraction for a New Zealand wood being for Maire, 0.670, the greater part being under 0.5. On reducing the experiments in Barlow's work on "Materials and Construction" in a similar manner,

it will be found that this fraction ranges from 0.3 to 0.5, or a little more, so that the Sydney results may be considered, from whatever cause, as abnormal.

The practical result, however, is that, after the usual allowance for safety has been made in calculating the strength of any beam from the values of S found by the New Zealand experiments, the load will be found to be satisfactorily within the elastic load of the same timber as found from the Sydney results, so that, notwithstanding all discrepancies, the Dunedin results may be considered as sufficiently trustworthy for practical application. At the same time, the Tables show that the strength of the same wood varies greatly, according to the locality from whence the specimens come, and it would consequently be only a wise precaution to test samples of the wood actually proposed to be employed before fixing the dimensions of the principal timbers in any important engineering structure.

On the commencement of the experiments it was found that they required so much personal supervision, and to be conducted in so regular and systematic a manner, that it became desirable that they should be under the sole superintendence of one person; and, as I took a very lively interest in the subject, and could devote more time to it than my colleagues on the Associate Committee could satisfactorily spare from their other duties, I volunteered to take the entire superintendence, and am, in consequence, solely responsible for the work as completed; a number of the earlier experiments and a very large proportion of the calculations having been made by myself, and the remainder, subject to my revision, by Mr. R. W. S. Grieve, C.E., Superintendent of the Machinery Department of the Exhibition.

The experiments were conducted in the following manner:—A pressure of 50lbs. was applied for two minutes (as measured by a sand glass), and the sample was then released; 75lbs. were then applied for the same time; then 100lbs., and so on, increasing by 25lbs. each time. Each time the sample was released the point on the deflection scale to which it returned was read, and, when it came to be notably under the original reading, the specimen was allowed to remain unloaded for two minutes, to see whether it would in time further recover itself. When, however, there were indications that the point of fracture was nearly attained, the pressure was gradually and steadily increased, without being again removed, until the specimen broke, the observer keeping his eye on the deflection scale and noting its reading at the first crack, the maximum pressure exerted being indicated on the proper scale by a simple self-registering arrangement. After a certain number of specimens of the wood being examined had been treated in this way, the remainder, if any, were broken more rapidly by a gradually increasing steady pressure which was never relaxed. These experiments are specially noted in the "Remarks" column. This system was used throughout, except, that, when the first experiment shewed that the wood was very

weak, the first weight applied was 20lbs. only, and the regular increment varied from 10lbs. to 20lbs., according to the circumstances of the case.

The period during which each pressure was applied was certainly rather short to allow the weight to have its full effect, but it was adopted as a necessary compromise between the work to be overtaken and the time in which it required to be done. The rapidity with which the experiments were carried on may have had the effect of making the results somewhat high, but as the values of E should be equally influenced with those of S, and as the values of E are, as already shewn, not inconsistent with those ascertained at Sydney, there is no evidence that such has been the case.

The first Table contains, in a condensed form, the results of all the experiments; the second, or Abstract Table, is a digest of the first, giving the average results for each different wood in one line, except in one or two peculiar instances. Thus the value of Greenheart is given twice, (4 and 17, Table II.), the first being the result of the Paris experiments, and the second being extracted from Barlow's work. I can only account for the very great difference in the two values by the supposition that the woods came from very different soils, or were actually different timbers possessing sufficient resemblance to have received the same name (a very common occurrence).

Tasmanian Blue Gum (8 and 26), Kauri (38 and 48), and Red Pine (43 and 52) are also twice entered in the abstract, but I consider the higher values (8, 38, and 43) to be not above fair averages, and to be those which should be used as the data for calculating the proportions of structures; the smaller results being lowered by their including the experiments on waved, curled, and ornamental varieties, which would certainly never be selected for engineering works—indeed, I consider even the higher value for Red Pine to be at least a low average, as it includes experiments on an ornamental plank from Mount Flagstaff, which are considerably under the other averages.

The woods are arranged in both Tables in the order of the mean values of S. In Table I. they are further so arranged that the highest mean result shall be first, and each single experiment is similarly classified. The numbers in the first column are consecutive, and only applied to those experiments which were made at Dunedin, the Sydney and Paris results being otherwise distinguished. Column 2 contains the Native, Common, and Scientific Names of the woods, and, when known, the district from which they came; and Column 3 contains all the information that could be collected as to their qualities, habits and uses.

To ascertain the specific gravity (Col. 4), and the weight of a cubic foot (Col. 5, headed W.), the samples were all dressed exactly to one inch square and 17.28 inches long by gauge, the weight in Troy grains divided by 70 gives the weight of a cubic foot in pounds avoirdupois, and this multiplied by 0.016046 gives the specific

gravity. The next Col. E was ascertained from the formula *$E = \frac{l^3 W'}{a d^3 \delta}$, or, as in these experiments l, a, and d were all $= 1$, $E = \frac{W'}{\delta}$ simply. The value of E was calculated from all the deflections and weights producing them, so long as the elasticity remained uninjured, so that the tabular value is a mean, sometimes of as many as 9 or 10 results. (The theory requires that these results should be identical, and it was found that they were so in practice within reasonable limits.) *

The next two columns (headed δ and W′) are intimately connected, the one being the greatest weight carried with unimpaired elasticity, and the other the deflection caused by that weight. In the Dunedin experiments the weights were generally increased by 25lbs. at a time, so that W′ is always some multiple of 25, except in a few instances where the increment of weight was different, or where the results had to be reduced owing to the specimens not coming up exactly to the standard dimensions. In every case a value for W′ was selected *before* the corresponding deflections had become irregular or excessive, so that the tabular values may be considered safe and low. δ is the deflection corresponding to such value of W′.

In reducing δ from the results of experiments at Sydney and elsewhere on specimens of larger scantlings, it was assumed that a certain elongation of the upper fibres, which will be the same in all beams of the same timber, must be the limit of safe deflection; or, in other words, that the element of maximum safe deflection, as well as the element of deflection at the instant of fracture, must be a constant quantity, and that therefore the actual deflection in any case will vary as $\frac{d}{l^2}$ (see Barlow, p. 95) where d = the depth of the beam, and l = its length. Therefore, putting Δ = the limit of safe deflection as observed in beams of any scantling, δ for these Tables will be found from the formula $\delta = \frac{d\,\Delta}{l^2}$, observing that only half the length of the beam must be taken for l in the case of beams supported at the ends and loaded in the middle.† The value of W′ is then found from the formula $W' = \delta E$.

The next, Col. S, is the most important of all, as giving the ultimate strength of the timber. The values extracted from Barlow's work and elsewhere, have been divided by 12, to reduce the results to a uniform standard of one foot long, which is considered more convenient than the old unit of one inch.

* In Barlow's work E is calculated for a unit of one inch long and one inch square. In this Table the unit has been assumed as one foot long, so that Barlow's E has to be divided by 12^3 or 1728, and *vice versa* to get the corresponding quantities.

† This formula may be applied to existing works in which the beams show considerable deflection, to ascertain whether the limit of safe deflection has or has not been exceeded. Of course the results must be considered as only approximate.

The next column, headed δ', is the ultimate deflection. When results had to be reduced from other scantlings, the same formula was used as was applied to calculate δ, but, as the final deflections are always irregular, too much dependence should not be placed on the results.

Column $\frac{\delta'}{\delta}$ is perhaps more curious than useful, but it is interesting as an analysis of the varying characteristics of woods of different countries, and the information it contains may at times be found of service.

Column $\frac{W'}{S}$ was calculated mainly for the purpose of investigating some discrepancies between the results of experiments at Dunedin, and those conducted elsewhere. It also affords a rough indication of what fraction of the breaking weight of a beam might be assumed as the safe load, and shows that one-fourth of the breaking weight may in most cases be considered *very safe* for New Zealand woods.

The two last Columns headed λ and W'' are the results of an attempt to render visible the effect of the specific gravities of the different timbers. The attempt has not been very successful, and probably some better method of attaining the same end may occur to others, but the results are interesting and not without a practical value. Column λ shows the length of a beam measuring 12×6, which will just break with its own weight, when supported at both ends, it was calculated from the formula $l = \sqrt{\frac{13824}{W}}$, where W = the weight of a cubic foot ($l = \frac{8bd^2S}{W}$ = formula for distributing load; in this case $b=6$, $d=12$, and $W = \frac{1}{2}\, l\, W$; hence doubling the numerator $l^2 = \frac{13824\ S}{W}$, and l is found as in the formula) The results show that the ultimate strength of the woods is intimately connected with their weight or specific gravity; the *absolute strengths* range from 468·6 to 32, or upwards of 14½ to 1, while the lengths of themselves that the woods will carry range only from 324½ to 154; or a little more than 2 to 1, so that the strength obviously increases very little faster than the weight.

Column W'' shews the breaking weight of a beam with a clear space of 20 feet supported at both ends and loaded in the middle, the proportions being in all cases the same, or depth = twice breadth, but the actual dimensions being varied so as to reduce all kinds to a uniform weight of 20lbs. per lineal foot, this weight being adopted, as 40lbs. per cubic foot may be considered a fair average of the weight of light woods. The results are very curious, and shew that the light woods when treated in this way are invariably the strongest, if we except the Jamaica Iron-wood, which is in every respect an extraordinary timber. It will be observed that Whau is actually, when treated in this way, the strongest wood in the Table, as its breaking weight is 15½ tons, while the best Tasmanian Blue Gum breaks with about

10 tons. This apparently anomalous result will become intelligible when the actual dimensions of the beam are calculated, the Blue Gum beam being 4.67 in. broad by 9.34 in. deep, and the Native Cork wood (Whau) beam, 11.07 in. broad, and 22.14in. deep.

The results in this Column were calculated by the formula $W''=\frac{29.52\ S}{W\ 3/2}$, which was arrived at as follows: b and d being the breadth and depth of the beam as usual; W, weight of a cubic foot; and S, the tabular value of the wood; a 6" × 12" beam has a sectional area of 72 sq. in., and the assumption is that such a beam is to weigh 40lbs. per cubic foot; ∴ area × W = 72 × 40; but the breadth is in all cases to be half the depth, $\therefore b = \sqrt{\frac{\text{area}}{2}}$, and area $= 2\ b^2$, therefore substituting and dividing, $2\ b^2=\frac{72\times 40}{W}$, and $b=\frac{37.95}{\sqrt{W}}$. Again, the usual formula for a beam loaded in the centre is $W=\frac{4bd^2S}{l}$, and here $d=2\,b$ and $l=20$ $\therefore$ $W=\frac{16b^3S}{20}$, and further dividing by 2240 to reduce the results to tons, $W=\frac{16b^3S}{4480}=\cdot 000357b^3S$, and substituting the value of b found above, $W=\cdot 000357\ S\left(\frac{37\cdot 95}{\sqrt{W}}\right)3=\frac{19.52\ S}{W\ 3/2}$.

The inferences to be drawn from Columns λ and W'' are somewhat important. They show that in very long spans at least, a greater proportion of the strength of a heavy timber is absorbed by its own weight than is the case when lighter timber is used, and they also serve to indicate the most suitable timber to be employed in any particular case. Thus, when the weight must be limited, but size is of no consequence, a timber of low specific gravity will make the strongest work; when, on the other hand, it is an object to keep down the sectional area, greater strength will be obtained in moderate spans by the use of a denser wood. Thus, for the cross-ties and walings of a timber jetty, in an exposed situation, I should be inclined to select a dense timber, so as to procure the necessary strength while exposing but a small surface to the waves, while for the deck beams I should prefer a lighter wood as forming stronger work. For the floor of a warehouse, if there be plenty of room, the wood of low specific gravity would, weight for weight, make the most satisfactory work, and so on.*

In pointing out these peculiarities, it is proper to state that when the weight of the structure itself is taken into account, as it always is by properly-educated practi-

* The results in the four last columns of the Abstract Table will not be found altogether to agree with the results which would be arrived at by the proper formula when applied to the given data. The reason is that S in the abstract Table is the mean of all the experiments recorded, while W" is the mean from those experiments only which furnished the necessary data. I did not consider it necessary to calculate a fresh value for W" for the abstract, as the results given are sufficiently accurate for the object in view. A similar explanation applies to discrepancies in the other columns.

tioners, the ordinary formulæ will answer every purpose, and indeed must be used to arrive at the proper dimensions to be adopted. It is only claimed for the Table that it renders the effect of specific gravity more visible, so as to arrest the attention, and to indicate at least approximately the most suitable timber for any case which may arise.

On an examination of the General Table, it will be seen that the New Zealand woods compare very fairly with those which we have been accustomed to consider as standards, the absolute strength of very many being above that of British Oak, and all being stronger than Elm (except Whau, which can scarcely be called a wood). New Zealand woods are certainly for the most part short in the grain, and break with little warning—though there are a number of valuable exceptions; but it will be observed that the ratio of safe load to breaking weight is high, which to a great extent compensates for this peculiarity. The Table indicates the probability that Black and Red Birch will be largely used for public works in future, as they grow to a very large size, and possess many valuable properties. Red Pine should come into more general use, displacing for many purposes the woods imported from America and the Baltic: indeed it is believed that had the Waikava, Catlin's River, and Stewart's Island Red Pine been represented in the experiments, (and it is greatly to be regretted that the mill-owners sawing these woods did not respond more freely to the call of the Commissioners,) the average result would have been higher than it is.

Kauri is too well known to require mention here, and Totara is also well known, though not so extensively and so highly esteemed as it seems to deserve. It is certainly desirable that all the experiments should be repeated and verified on a larger scale, and it is to be hoped that the General Government will take such steps as to be in a position to undertake to test all samples which may be forwarded to them for the purpose from any part of the Colony. Another point which calls for further investigation is the proper season for felling timber, about which little is known. In countries where the winter is more severe, it is generally considered that the best time to fell timber is in mid-winter, when the trees are almost entirely free from sap, and the last-formed wood has to some extent consolidated; but the next best period is considered to be about mid-summer, after the foliage has been fully developed, when the tree appears to *rest* before commencing the formation of wood,—at which time also it is remarkably free from sap. Spring and autumn are the worst seasons for felling. As, owing to the mildness of the New Zealand winter, trees, except at considerable elevations, never entirely cease to grow, it may probably be found that mid-summer is the best season for felling in this Colony; but the subject requires, and deserves, a thorough investigation, there being few questions which could be taken up by the Colonial Government with a better prospect of ultimate public

benefit. When the proper season for felling has been ascertained and adopted, and when more attention is paid to the important question of careful seasoning, it will probably be found that the N. Z. woods will give even higher results than those in the Tables.

I append a copy of the Class Table published by the "Australian Lloyd's," from which it appears that but one New Zealand timber, Kauri, is officially recognised. Such woods, however, as Manuka, Kohwai, Black Birch, Rata, Black Pine, Maire, Red Birch, Red Pine, and Totara, probably require only to be better known, to be admitted for those purposes for which each is best adapted.

With regard to *durability in moist situations*, it is difficult to collect authentic information, as so much depends on climate, and the climate of New Zealand is very variable. The most generally esteemed woods, however, appear to be Manuka, Totara, Black Birch, Black Pine, Red Mapau, and a wood not represented in the Exhibition, Puriri; but doubtless there are others which have a high local reputation.

Another question most difficult to answer is that which refers to the *durability of different woods in the sea*, and especially their *resistance* to the *marine boring worms*. So much depends on the quality of the timber itself and the soil on which it grew, so much on the size of the specimens, and so much on the locality where they have been used, (the worms being much more numerous and active in some places than in others), that it is impossible to arrive at any definite conclusions on the subject.

At Dunedin, situate at the head of a bay, or inlet, about 12 miles from the open ocean, where there is no current, and where the water is to some extent freshened by the drainage of the town, and a few small streams, Manuka, Kohwai, and Miro, and probably some other woods, are perfectly sound after standing 13 years in the old jetty, though the piles are little better than saplings.

At Port Chalmers, again, six miles from the sea, the Manuka piles are perfectly sound after being driven about five years, while Miro fender piles were very seriously injured in 21 months by the *Teredo*. Kohwai piles at the same place were entirely eaten through in less than 14 years, mainly by the *Limnoria*, though it was also attacked by the *Teredo*, and it is worthy of notice, that while the smaller worms did not appear to work below the surface of the ground, the *Teredo* flourished a considerable way down. At Moeraki, on the coast, Totara was attacked in 16 months, but the piles were mere saplings some 10 to 12 inches in diameter, so that the native woods can scarcely be said to have been put on their trial yet in Otago.

In Wellington and Auckland, Totara, when well grown, is considered one of the best pile timbers in New Zealand, though not proof against the worm. The Harbour Master at Auckland, W. Ellis, Esq., informs me that after Red Totara piles had been driven 6 years the worm had cut clean through some of them, chiefly about low water mark, but that not more than about 8 per cent. of the whole were attacked. He states that the general opinion is that Red Totara piles, if driven immediately after being felled, and with the natural juices still in them, are proof against the worms, and considers that the fact that numbers of the piles are still untouched is in favour of the accuracy of this supposition. On the whole subject further observation and longer experience is required, the probability being that no wood is absolutely proof against these destructive borers, though one wood may stand well in one locality and another in another. It is not at all improbable that the Totara juices may be inimical to the worms, and so may retard their progress, but it will probably be *only retarded*, as the juices must get dried up or diluted in time, or the worms may become accustomed to them. I have seen the *Limnoria terebrans*, in Scotland, revelling on timber thoroughly saturated with creosote, which in some parts of England appears to be a specific against them; and it has been experimentally proved that low organisms can thrive under apparently impossible conditions, one observer having succeeded in accustoming the common cheese mites by degrees to strychnine, so that at length they lived and throve on that deadly poison in an absolutely pure state.

More information is then absolutely required as to the durability of New Zealand woods in the sea at different parts of the coast; meantime, Manuka may be considered, in the southern portions of the Colony at least, as decidedly the most durable, and Totara also occupies a foremost place. Black Pine has a good name also for durability, but it has not been extensively used in exposed situations, and it is probable that Rata would stand well.

Appended is a Table (also copied from the Australian Lloyd's Regulations) shewing the action of marine worms on different woods in Victorian waters, from which it will be seen that Swan River Mahogany appears to stand pre-eminent for durability, and that She Oak (unfortunately a small tree) is next best; Blue Gum, on the whole, appears to stand third, but it has no very decided advantage over the others, and indeed the whole Table, though very valuable, only shows how much room there still is for further observation on the subject.

As works of reference are difficult of access in New Zealand, I shall conclude by giving as shortly as possible:—

Rules for calculating the strength, &c., of beams from the tabular numbers.

Putting—

S = the tabular number for the absolute strength of the wood:

b = the breadth of the beam in inches.

d = the depth of the beam in inches.

l = the length of the beam in feet.

W = the breaking weight of the beam in lbs.

1. To find the strength of a beam fixed at one end and loaded at the other. $W = \frac{b\,d^2\,S}{l}$. In words, multiply the tabular No., S, for the given wood by the breadth of the beam in inches, and by the square of the depth in inches, and divide the result by the length of the beam in feet—the result will be the weight in lbs. which will just break it.

Note.—This rule will apply to a crane post not supported above the ground, the dimensions being measured at the throat, and the radius of sweep of the crane being taken as the length of the beam.

2. When the beam is fixed at one end and uniformly loaded over its whole surface, the breaking weight will be twice as great as in the first case, or $W = \frac{2b\,d^2\,S}{l}$. This would apply to a corbelled balcony, or landing-place projecting from a jetty.

3. When the beam is supported at both ends and loaded at the centre, $W = \frac{4b\,d\ S}{l}$ or four times the result found by the first rule.

4. When the beam is supported at the ends and uniformly loaded, as in a granary or warehouse floor, the breaking weight will be eight times the result found by the first rule, or $W = \frac{8b\,d^2\,S.}{l}$

5. When the beam is securely fixed at the ends and loaded in the middle, the strength will be six times the first result, or $W = \frac{6\,b\,d^2\,S}{l}$, and when similarly fixed and uniformly loaded it will be 12 times the first result, or $W = \frac{12b\ d^2\,S}{l}$; but these two cases can scarcely ever occur in practice, from the impossibility of fixing the ends of the beams in a sufficiently rigid manner. The only case which at all approximates to a beam *fixed* at the ends, is when the same beam extends continuously over several supports, and in that case accordingly some increase of strength over that found by Rule 3 or 4 may be counted on.

In practice the beam should never be loaded with *more* than one fourth of the breaking weight, as ascertained above, but it must be left to the judgment of the designer to determine how much less than one fourth should be considered the safe working load. In deciding this, attention has to be paid to the nature of the structure and its exposure to the weather, and also to the nature of the load—for example whether it is a steady weight, or whether heavy masses will sometimes be thrown down

over the beam, &c. For Bridges some Engineers make the breaking weight of the beams ten times the maximum load the bridge will have to carry.

6. The length and breaking weight of a beam being known, to find its dimensions, (the breaking weight being assumed as at least four times what the beam will require to carry). Suppose the beam supported at the ends and loaded at the centre; this can only be solved by assuming a dimension for either the breadth or the depth. Suppose the breadth assumed, then $d = \sqrt{\frac{l\,W}{4b\,S}}$; or, in words, the depth will be found by dividing the length, multiplied by the breaking weight, by four times the assumed breadth multiplied by the tabular number S, and taking the square root of the quotient.

If the depth be assumed $b = \frac{l\,W}{4d^2\,S}$; or the length multiplied by the breaking weight and divided by four times the square of the depth multiplied by the tabular number. If the beam be to be square, the side of the square will be found from the formula $b = d = \sqrt[3]{\frac{l\,W}{4\,S}}$, or the cube root of the length multiplied by the breaking weight, and divided by four times S.

7. When the beam is fixed at one end and loaded at the other, the formula will be $b = \frac{l\,W}{S\,d^2}$, $d = \sqrt{\frac{l\,W}{b\,S}}$; in square beams, $b = d = \sqrt[3]{\frac{l\,W}{S}}$, or the same formula as before, taking S only instead of 4 S.

When the weight is uniformly distributed the same formula will apply; but W in this case will represent only half the required or given weight.—(*Barlow on Materials and Construction*, p. 144.)

8. Cylindric Beams, such as crane posts, are two-thirds the strength of a square beam of the same length, the diameter of the cylinder being equal to the side of the square.

In calculating the elasticity of a beam, the simple formula for a beam fixed at one end and loaded at the other is, $E = \frac{l^3\,W'}{a\,d^3\,\delta}$ from which the tabular values of E are calculated, δ being the observed deflection, and W′ the weight which produces it. Thus, any four of the five qualities l, W′, a, d, and δ being known or assumed, the fifth may be calculated from this formula, when properly inverted, as follows:—

$$a = \frac{l^3\,W'}{E\,d^3\,\delta};\quad d = \sqrt[3]{\frac{l^3\,W}{E\,a\,\delta}};\quad \delta = \frac{l^3\,W}{a\,d^3\,E};\quad W' = \frac{a\,d^3\,\delta\,E}{l^3};\quad \text{and } l = \sqrt[3]{\frac{a\,d^3\,\delta\,E}{W'}}.$$

9. When a beam is supported at both ends and loaded in the middle, the prime formula is $\frac{l^3\,W'}{16\,a\,d^3\,\delta}$ = the same E as before, from which, by inversion, we have

$$a = \frac{l^3\,W'}{16\,d^3\,\delta\,E};\quad d = \sqrt[3]{\frac{l^3\,W'}{16a\,\delta\,E}} \text{ and so on.}$$

10. When a beam is fixed at the one end and uniformly loaded, the prime formula is

$$\frac{3\,l^3\,W'}{8\,a\,d^3\,\delta} = E.$$

11. When a beam is supported at both ends and uniformly loaded, the formula becomes $\frac{5\,l^3\,W'}{128\,a\,d^3\,\delta} = E$; both of which formulæ may be treated to find any one unknown element as illustrated in No. 8.

Lastly, if it be desired to ascertain whether the deflection of any beam in an existing structure be within the limits of safety, the approximate formula $\delta = \frac{d\,\Delta}{l^2}$ may be applied, where Δ is the observed deflection of the beam, and the resulting δ should be within the tabular safe deflection (Column δ); the result, however, must not be too much depended on, as the deflection may be complicated by the "casting" or warping of the timber.

The formulæ depending on E are very seldom used, as, if the timber be never loaded in excess of one-fourth of the calculated breaking weight, its elastic force will never be impaired, and it is seldom of consequence to know what the actual amount of deflection will be; as, however, special cases sometimes occur in which the deflection must not exceed special limits, it has been considered advisable to show the method by which the proper proportions may be ascertained.

In conclusion, I have only to apologise for the imperfect manner in which my task has been accomplished, and to entreat forbearance towards any errors which may be detected; many thousand operations were required in calculating the Tables, and I cannot expect to have succeeded in keeping the work entirely free from mistakes; great care has, however, been taken, and whatever errors there may be will not, it is hoped, vitiate the results to any extent. The work, though laborious, has been a labour of love, and I trust my professional brethren in New Zealand will look kindly on this first attempt at supplying a want which all must have often felt—viz: a full and complete account of the Native Woods, and reliable data from which to calculate the proportions of structures.*

JAMES M. BALFOUR,

Marine Engineer.

Dunedin, December 15th, 1865.

---

* The Editor must apologise for the *form* in which Mr. Balfour's Paper has been printed; which the exigencies of Colonial printing rendered quite unavoidable.—ED.

APPENDIX C.

No. I.—TABLE of Results of Experiments on New Zealand and other Colonial WOODS, made for the Commissioners of the New Zealand Exhibition, under the direction of James Melville Balfour, C.E., Provincial Marine Engineer of Otago.

NOTE.—The Woods are arranged in the order of the mean values in Column S, any exceptional specimens being omitted in calculating the mean. The different experiments on each variety of Timber are also arranged in the order of the values of S. The experiments made at Dunedin are numbered consecutively in the first Column. Those which are not numbered, but marked with an asterisk, were made at Sydney Mint in 1856, by Capt. Ward, R.E., and are added for the sake of comparison.

Consecutive Number of Experiment	NAME OF WOOD. — 1st, Native Name. 2nd, Settlers' Name. 3rd, Botanical Name. — 4th, Locality from which specimen comes.	Average dimensions of Timber; also, its qualities and uses, and the nature of the soil on which it thrives best.	Number of Specimen.	Specific gravity.	Weight of a cubic foot.	Elasticity, from the formula $E=\frac{l^3 W'}{b d^3 \delta}$ } In these experiments $=\frac{W'}{\delta}$	Greatest deflection in inches, elasticity remaining uninjured.	Greatest weight carried with unimpaired elasticity. Generally δE	Ultimate strength, from the formula $S=\frac{l W}{a d^2}$ In these experiments S=W simply.	Deflection in inches at instant of fracture.	Ratio of flexure at point of fracture to safe deflection or $\frac{\delta'}{\delta}$	Ratio of weight carried with unimpaired elasticity to breaking weight or $\frac{W'}{S}$	Length of a beam 12 inches deep and 6 inches broad, supported at both ends, which will just break with its own weight, from the formula $\lambda=\sqrt{\frac{13824\,S}{W}}$	Breaking weight at centre of a beam 20 feet clear span (supported at ends) reduced to a uniform weight of 20 lbs. per lineal foot, and of the proportions, depth equal twice breadth, from the formula $W''=\frac{19{\cdot}52\,S}{W^{\frac{3}{2}}}$	REMARKS.
			No.	S.G.	W lbs.	E $\frac{W'}{\delta}$	δ inches	W'' lbs.	S lbs.	δ' inches	$\frac{\delta'}{\delta}$	$\frac{W'}{S}$	λ feet.	W'' tons.	
1	MAIRE—	Small tree with the habit of a *Metrosideros* (Rata).	1	1·183	70·63	322·5	·80	225	335	2·00			255·89	11.040	Good fibrous fracture.
	Black Maire		2	1·166	72·68	250·0	·80	200	335	1·86			252·42	10.550	Broke suddenly.
	Eugenia Maire, var.		3	1·147	71·47	290·2	·70	200	327	2·22			251·49	10,560	Good fibrous fracture.
	Hawke's Bay		4	1·193	74·40	229·4	·64	150	260	2 00			219·8	7.907	Broke at a slight flaw.
			M	1·159	72·29	273·0	0·73	193	314·2	2·02	2·77	·614	244.90	10.014	*Mean results.*
2	TITOKI—	Trunk 15 to 20 ft high and 12 to 20 in. dia. The wood has similar properties to ash, and is used for similar purposes. Its toughness makes it valuable for wheels, coach-building, &c.	1	·929	57·94	231	·56	125	250	3·20			244·23	11.06	Good warning. Strong fibrous fracture. All similar. In all neutral axis very high, arguing a high resistance to tension.
	Titoki		2	·915	57·06	284	·42	100	248	2·40			245.13	11·23	
	Alectryon excelsum		3	.904	56·31	222	·56	125	246	2·60			245·74	11·86	
	Wellington		M	·916	57·10	229	·51	116	248	2·73	5·35	·468	245·08	11·22	*Mean results.*

3	MAPAU, also Tarrata (Hector) Black Mapau *Pittosporum tenuifolium* Vicinity of Dunedin. [In the Auckland Collection Mapau is called Birch.]	Never attains to any great size, though in woods it shoots up to a considerable height. Used for fence rails occasionally.	1						300	2.00					1 Broken by a gradually increasing pressure. 2 & 3 Very tough and fibrous, only crippled at last. 4 Broken by a gradually increasing pressure. 5 Tough and fibrous.
			2	·959	59·79	218·6	·56	125	270	2.64			249·81	11.396	
			3	·964	60·07	213·0	·58	125	225	2·20			227·54	9·431	
			4						220	2.26					
			5	·972	60·57	214·0	·60	125	200	1·54			217·93	8·788	
			M	·965	60·14	215·2	·58	125	243	2·13	3·67	·514	231.76	9·872	*Mean results.*
4	MANUKA— Manuka *Leptospermum ericoides,* Wellington		1	·943	58 77	266·9	·52	150	302	2·72			266·53	13·081	1 Yielded gradually—very fibrous. 2 Hung some time before parting—fibrous.
			2	·872	54·39	190·7	·52	100	225	2.20			239·15	10·948	
			M	·907	56·58	228·8	·52	125	263·5	2·46	5·7	·474	252·84	12·014	*Mean results.*
5	MANUKA— Manuka *Leptospermum ericoides* Vicinity of Dunedin	Highly valued in Otago for jetty and wharf piles as it resists the marine worm better than other timber found in the Province. It is also extensively used for house piles, fencing, and especially for firewood. Its durability and and other valuable qualities would ensure its much more extended use, were it to be had of larger sizes. 28 to 30 feet long, 14 inches diameter at the butt, and 10 inches at the small end, may be considered the largest attainable dimensions, though shorter lengths can be procured in quantities, with a diameter considerably greater.	1						280	1·90					1 Broken by gradually increasing pressure.
			2	·967	60·28	229·1	·68	150	255	2·60			241·80	10·63	2 Good warning, fibrous.
			3	1.042	64·95	242·2	·32	75	245	2·0			228·36	9·135	3 Gave way very slowly.
			4	·953	59·38	250·	.40	100	245				238·82	10·45	4 Broke suddenly at a flaw—final deflection not noted
			5	·941	58·64	242·2	·32	75	215	2·0			225·14	9.345	5 Av. sample. 6 Fibrous fracture
			6	·955	59·54	214·6	·48	100	200	1·4			215·48	8·49	
			M	·972	60·96	235·6	·44	100	240	1·8	4·1	·417	229·92	9.61	*Mean results.*
*	Manuka	Affects a comparatively poor soil, and grows on large tracts, to the exclusion of all other trees.	1 2	·906	56·46	260·08	·57	145	211.8	2.277	4·0	·686	227·72	9·969	1 & 2, Mean of two experiments at Sydney Mint, specimens were 1·9 inch square and 5 feet long between supports.
		The lightest colored wood, called "White Manuka," is considered the toughest, and forms an excellent substitute for "Hornbeam" in the cogs of large spur wheels.	Av.	·943	59·0	239·5	·49	115	239	2·05	44·3	·482	234·52	10·224	General average of all recorded experiments on Manuka.
6	KOHWAI— Kohwai *Sophora tetraptera,* var. *grandiflora* Wellington	Said to attain a large size in the interior of the North Island, but rarely over 12 to 16 inches in diameter in Otago. Timber is durable, and is used for piles in bridges, wharfs, &c., and for fencing. The wood has a strong resemblance to laburnum, the medullary plates, as in that wood, being lighter in color, than the woody fibre. It is well adapted for cabinet work and turnery.	1	1·006	62.69	194·7	·66	125	275	3·16			246·26	10·813	1 Only crippled at last,
			2	1·029	64·19	208·	·36	75	275	3·36			243·37	10·436	2 Very strong and flexible, only crippled at last
			3	1·037	64·66	257·5	·46	100	265	3·22			238·03	9·95	3 Crippled completely, but fibres only partially separated
			M	1·024	63·85	220·1	·49	100	271·7	3·25	6.43	·368	242·55	10·899	*Mean results.*
7	KOHWAI— Kohwai, or Goa Vicinity of Dunedin		1	1·03	64·11	166·8	·80	125	212	2·6			213·8	12·735	These samples were cut from a pile which had been twelve years in the Old Jetty Dunedin, and alternately wet and dry, but still perfectly sound.
			2	·834	51·98	184·2	·80	125	200	2·6			230·62	10·414	
			3	·942	58·71	166·7	·70	100	174	2·4			202·42	7·548	
			4	·880	54 85	139·7	1·10	125	170	2·8			207·0	8·166	
			M	·922	57·41	164·35	·85	119	189	2,6	3·06	·630	213·46	9·716	*Mean results.*
8	Kohwai Wakatipu District, Otago.		1	·667	41·57	187·4	·38	75	185	2·38			248·04	13·47	1 Broke slowly with fair warning
			2	·681	42·46	251·0	·44	100	184	1·6			244·75	10·77	2 Do. Do.
			M	·674	42·01	219·2	·41	87	184·5	1·99	4·85	·472	246·39	12·12	*Mean results.*
9	Koh wai Wakatipu District. (Another specimen).		1	·861	53·66	179·5	·60	100	202	2·9					1 Gave fair warning—2 Do. fibrous bark
			2	·841	52·41	240·0	·28	50	185·4	2,44					
			3	·803	50·01	200·99	·44	83	163	1·96					3 Carried last weight about 3 minutes parting slowly the while.
			M	·835	52·03	206·83	·44	78	183·5	2·43	5.52	·425	220·46	9·513	*Mean results.*
			Av.	·884	55·11	198 05	0·584	98	207·5	2·62	4·82	·487	227·97	10.236	Gen. av. on all the exp. on Kohwai.

No.	NAME, &c.	DIMENSIONS AND USES.	No.	S.G.	W	E	δ	W'	S	δ'	δ'/δ	W'/S	λ	W''	REMARKS.
10	TAWA— Tawa (*Nesodaphne Tawa*), Wellington.	Wood said to be inferior in quality and not durable.	1	·808	50·40	199·2	·72	150	240	2·12			256·57	1.309	Sudden short fracture; resists compression well.
		The Maoris used this wood for spears.	2	·790	49·26	209·9	·56	125	208	1·8			241·61	11·742	Broke very suddenly; short grain.
			M	·799	49·83	204·5	·64	137	224	1·96	3·06	·612	249·09	12·416	*Mean results.*
*	Tawa.		1	·685	42·69	201·42	·76	153·1	168·4	1·08	1·26	·909	223·01	11·78	Result of experiments at Sydney Mint, rejecting a sample stated to have been unsound. Dimensions of sample 1·9 in. square, and 5ft. long between supports.
			GM	·761	47·45	203·47	·68	142·4	205·5	1·65	2·49	·711	240·39	12·204	*General Mean* of all experiments on Tawa.
11	TOWAI— Black Birch (*Fagus fusca*), Wakatipu, Otago.	A large tree 40 to 60 feet high, often attaining a diameter of 8 to 12 feet.	1	·715	44·57	214·5	·44	100	250	2·30			278·46	16·397	Fibrous.
			2	·759	47·31	203·8	·74	150	235	2·44			262·03	14·092	Do., parted quickly.
			3	·664	41·40	225·0	·44	100	211	2·38			265·42	15·456	Long fibrous fracture.
			M	·713	44·43	214·4	·54	116	232	2·37	4·4	·50	268·64	15·315	*Mean results.*
12	TOWAI— Wellington.	A valuable timber, highly esteemed in Nelson and Wellington for public works, as being both strong and durable in all situations. Black birch is the only wood used in the construction of the Waiau-ua Bridge, designed by J. Blackett, Esq., C.E., Provincial Engineer of Nelson: a daring and very successful structure.	1	·911	56·76	239·0	·42	100	239·4	2·30			241·47	10·926	Long diagonal non-fibrous fracture.
			2	·847	52·8	230·0	·44	100	225·0	2·80			242·71	11·445	Fibrous.
			3	·695	43·33	159·0	·60	100	135·0	1·50			207·54	9·238	Longer cut and drier than the others.
			M	·818	50·96	209.3	·49	100	199·8	2·20	4·5	·50	230·57	10·536	*Mean results.*
*	Towai.		1	·869	54·16	265·82	·432	114·12	122·5	1·54	3·56	·932	176·82	5·998	Result of an experiment at Sydney Mint. Sample 1·9 in. broad, 3 ins. deep, and 5 feet long between supports.
			GM	·78	48·62	219·5	·508	108·8	202·5	2·32	4·32	·56	239·20	11·936	*General mean* of all experiments on Towai.
*	MIRO— Miro, but frequently confounded with Black Pine or Matai (*Podocarpus spicata*)	This tree attains large dimensions—40 to 60 feet high, and 2 to 3 feet diameter—and is valuable, but inferior in durability to the true Black Pine (for which it is often mistaken), especially when exposed to the action of moisture. The	1, 2	·957	59·64	280·25	·562	158	201·6	·866	1·54	·784	216·16	8·541	*Mean results* of experiments on two samples at Sydney Mint. Dimensions, 5 feet long, 1·9 in. square, supported at both ends.

13	Miro (*Podocarpus spicata*), Wellington.	wood is generally nearly white, and it is known from Black Pine by showing a kind of star pattern on the cross section. The growing wood is distinguished by the fruit—the Miro carrying a spike or cluster of berries, while the Black Pine berries are single. This wood is not well adapted for marine works, as the worms destroy it very rapidly. It would be excellent for joists and other work exposed to transverse strains, but protected from damp.	1	·671	41·88	229·7	·60	125	198	2·0			255·81	14.284	Yielded slowly at first, and then snapped suddenly.
			2	·693	43·20	206·0	·66	125	195	1·82			240·80	13·403	Broke suddenly.
			3	·658	41·02	155·0	·62	100	190	2·16			253·06	14·117	Sudden short fracture.
			M	·674	42·02	196·9	·63	117	194·3	1·99	3·16	·602	252·89	18·985	*Mean results.*
			GM	·787	49 07	230·24	·608	133	197·2	1·54	2·51	·675	238 20	11·777	*General mean* of all experiments on Miro.
14	RATA— Rata, sometimes Iron Wood, (*Metrosideros robusta*), possibly *M. lucida*, Wellington.		1	1·003	62·54	199·8	·48	100	236	2·86			228·45	9·313	Fibrous fracture, similar to Manuka.
			2	1·005	62·83	223·7	·56	125	210	2·86			214·95	8·229	Do.
			3	·880	54·86	218·5	·46	100	205	2·16			227·29	9·847	Do., but somewhat sudden
			M	·963	60·08	214	·50	108	217	2·63	5 26	·50	223·56	9·130	*Mean results.*
15	Rata (*Metrosideros lucida*), Stewart's Island.	This tree attains a height of 30 to 40 feet, and a diameter of 2 to 6 feet, and is found in all parts of New Zealand. Rata is plentiful on the West Coast of Otago, and in Stewart's Island, where it is much used for knees and timbers in ship-building. It is believed to be durable, and its strength would recommend its adoption in engineering works. It is a handsome cabinet wood, and would probably answer well for cogs of spur wheels.	1	1·146	71·429	330·5	·34	100	255·4	3·12			222·33	8·256	Results of experiments on two different samples of timber. General character the same in all the pieces, the fracture very slow, with good warning and great resistance to compression. Nos. 2 and 8 were broken by a gradually increasing steady pressure.
			2						244·0	2·44					
			3	1·078	67·191	263·3	·32	75	212·8	2·60			208·49	7·486	
			4	1·010	62·953	233·7	·50	100	200·0	2·20			211·65	7·971	
			5	1·045	65·155	188·97	·44	75	179·4	2·40			195·08	6·656	
			6	1·062	66·171	141·60	·54	75	175·0	1·84			191·21	6·345	
			7	1·073	66·857	137·50	·80	100	175·0	2·20			190·22	6·247	
			8						175	1·90					
			M	1·069	66·63	215·93	·49	87	202	2·34	4·77	·43	203·16	7·160	*Mean results.*
*	Rata	From its density, it would probably resist the marine worm well, and if it could be procured in quantities of good dimensions, might probably take the place of Manuka for piles in marine structures.	1, 2, 3	1·078	67·18	331·0	·55	98	159·3	0·83	1·51	·62	180·84	5·646	*Mean results* of three experiments at Sydney. Samples stated to have been somewhat cross-grained. One specimen was 1·9 in. broad, 3 ins. deep; the others 1·9 in. square, and all 5 feet long between supports.
			GM	1·045	65·13	244·2	·51	93	196	2·08	4·18	·50	202·68	7·274	*General mean* of all experiments on Rata.
16	MAPAU— Red Mapau, in Auckland Collection called Red Birch, (*Myrsine Urvillei*), Otago Peninsula.	Small tree, seldom exceeding 12″ diameter in Otago; much used for fence-rails, also for piles in marine and other structures; said to be durable; a deep red colour, and would be handsome in cabinet work. The wood is extremely subject to the ravages of a boring beetle.	1						265	3·0					
			2	1·043	64·992	165·0	·48	75	225	3·0			218·77	8·381	Sudden but fibrous fracture.
			3	·997	62·147	155·0	·68	100	222	3·4			222·22	8·843	Do., stands compression well.
			4						192	2·0					
			5	1·048	65·32	176·5	·58	100	184	1·1			197·33	6·802	Broke short at last.
			6	1·018	63·468	148·0	·54	75	175	2·28			195·24	6·755	Gradual silent fracture.
			M	1·026	63·98	161·1	·57	87	210·5	2·46	4·32	·413	208·39	7·695	*Mean results.*

No.	NAME, &c.	DIMENSIONS AND USES.	No.	S. G.	W.	E.	δ	W′	S.	δ'	$\frac{\delta'}{\delta}$	$\frac{W'}{S}$	λ	W″	REMARKS.
*	Mapau, believed to be Red Mapau (*Myrsine Urvillei*)		1} 2}	·923	57·52	187·44	·58	107	138	·91	1·57	·777	181·97	6·164	*Mean* of two sets of experiments at Sydney—one specimen stated to have been inferior. Dimensions, 1·9 in. square, and 5 feet long between supports.
	Red Mapau		G M	·991	61·82	169·88	·57	92	192·4	2·07	3·63	·504	199·6	7·184	*General mean* of all experiments on Red Mapau.
17	MATAI— Black Pine (*Podocarpus ferruginea*). Wakatipu district, Otago.	A large-sized, valuable timber, sometimes attaining a diameter of 4 feet. The heart-wood of full-grown specimens is of a reddish hue, surrounded by about an inch of sap-wood concentric with the bark and well defined, which renders it easily distinguished from Miro when seen in section. It is considered durable both wet and dry, and is much used for piles in engineering structures.	1			163·4	·92	150	276·1	2·42					Nos. 1 and 3 were, by oversight, not weighed. No. 5 was broken by gradually increasing steady pressure. The fracture in all was non-fibrous and sudden; several samples flew into three pieces with a loud report: at the same time the cohesion was obviously good, and the resistance to compression remarkably high.
			2	·756	47·09	189·8	·52	100	265·0	1·80			278·92	16·00	
			3			177·5	·86	150	263·9	2·14					
			4	·792	49·36	190·35	·64	125	200·0	2·00			236·68	11·256	
			5						172·4	1·50					
			M	·774	48·22	180·26	·735	131	237·5	1·96	2·66	·551	257·8	13·628	*Mean results.*
18	Matai. Wellington.		1	·767	47·79	166·5	·60	100	203	1·70			242·33	11·99	1 Fracture short but ragged. 2 Carried last weight sometime before parting.—3 Sudden fracture.
			2	·712	44·36	212·3	·58	125	200	1·36			249·65	13·21	
			3	·669	41·70	148·5	·66	100	175	1·40			240·86	12·68	
			M	·716	44·62	175·8	·61	108	192·7	1·49	2·44	·560	244·28	12·63	*Mean results.*
19	Matai. Wakatipu District, Otago.		1	·607	37·86	186·0	·74	100	200	2.76			270·24	16·755	1 Sudden short fracture. Neutral axis very low.—2 Broken by gradually increasing pressure. 3 Sudden short fracture 4 Do., very flexible specimen.
			2						200	2·4					
			3	·604	37·68	121·09	·64	75	175	2·8			253·55	14·795	
			4	·624	38·88	106·9	1·00	100	175	8·40			249·42	14·088	
			M	·612	38·12	121·33	·79	92	187.5	2·84	3·60	·490	257·74	15·211	*Mean results.*
20	Matai. Vicinity of Dunedin Otago.		1	·561	34·97	154·4	·64	100	170	2·00			259·23	16·043	Usual sudden fracture.
			2						168·3	1·80					Broken by gradually increasing pressure.
			3	·597	37·19	165	·46	75	161	2·86			244·62	11·49	Usual fracture.
			4	·572	35·66	125·0	·60	75	140	1·76			232·97	12·582	Do.
			5	·601	37·45	115·9	·46	50	126·5	2·56			216.09	10·77	Do.
			M	·583	36·32	140·1	·54	75	153·2	2·2	4·06	·496	238·28	12·784	*Mean results.*

*	Matai—		1	·653	40·70	170·56	·77	131	138·8	0.82	1·06	·942	217·13	10·432	Results of an experiment at Sydney Mint; specimen 1·9 in. broad, 3 in. deep, and 5 feet long between supports.
			G M	·658	40·74	150·22	·67	103	190	2·08	3·10	·542	245·51	13·257	*General mean* of all experiments on Matai.
21	MAIRE— Maire *Eugenia Maire* Wellington.	Small tree 30 to 50 feet high, with the habit of a *Metrosideros* (Rata). Affects swampy ground.	1	·943	58.77	224·4	·44	100	225	1·46			230·05	9.746	1 Short fracture; resists compression well.—2 Broke rather suddenly, but fibrous.—3 Good fracture.—4 A flaw in this specimen.
			2	·919	57·26	242·9	·66	150	224	2·02			232·55	10·090	
			3	·920	57·33	190·6	·56	100	223	2·56			231·89	10·036	
			4	·963	60·00	215·5	·48	100	175	1·40			200·80	7·349	
			M	·936	58·34	218·3	·53	112	212	1·86	3·50	·528	223·82	9·305	*Mean results.*
22	Maire— Hawke's Bay.	Excellent for fencing.	1						170	1·6					1 Broken by gradually increasing pressure.—2 Good fibrous fracture.—3 Do.—4 Do.—5 Do.—6 Broke by gradually increasing pressure.
			2	·671	41·83	143·3	·72	100	150	1·9			222·65	10·87	
			3	·627	39·08	135	·76	100	150	2·2			230·34	11·98	
			4	·618	38·54	125	·80	100	150	1·8			231·94	12·23	
			5	·660	41·14	141·3	·72	100	140	2·0			216·89	10·35	
			6						135	1·6					
			M	·644	40·15	136·1	·75	100	149	1·8	2·40	·670	225·45	11·357	*Mean results.*
			G M	·790	49·24	177·2	·64	106	179·7	1·82	2·84	·590	224·63	10·331	*General mean* of all experiments on Maire.
23	TAWIRI KOHU KOHU (*Buchanan*) White Mapau (Called White Birch in Auckland Collection) *Carpodetus serratus* Otago Peninsula.	A shrub, or small tree, 10 to 30 feet high, the trunk usually slender; suitable for axe handles.	1						210	3·90					1 & 2 Broken by gradually increasing pressure.
			2						200	3·40					
			3	·917	57·17	186·5	·52	75	191	2·80			214·73	8·608	3 to 7 Tough; yielded slowly.
			4	·864	53·87	189·0	·44	75	180	3·76			214·92	8·885	
			5	·709	44·22	169·3	·80	125	170	1·76			230·54	11.280	
			6	·797	49·66	150·5	·56	75	156	3·80			208·38	8·698	
			7	·822	51·27	139·0	·36	50	136	3·30			184·11	6·426	
			M	·822	51·24	166·86	·54	80	177·6	3·25	6·0	·450	210·53	8·780	*Mean results.*
24	KAURI— Kauri (mottled var.) *Dammara australis* Auckland.	A magnificent tree, sometimes 120 feet high and upwards, and attaining a diameter at the base of 10 to 20 feet. The trunk is sometimes 80 to 100 feet high before branching. Grows best near the sea on wet clay land.	1	·646	40·29	190·7	·52	100	190	2·0			255·29	14·496	1 Sudden long diagonal fracture.—2 Broken by gradually increasing pressure.—3 Broke short and suddenly.—4 Do. do.
			2						187·7	2·2					
			3	·611	38·08	178·7	.42	75	185	2·0			259·14	15·187	
			4	·591	36·83	164.25	·62	100	168	1·78			251·11	14·668	
			M	·616	38·40	177·88	·52	92	182·7	2·0	3·84	·504	255·18	14·784	*Mean results.*
25	Kauri— Auckland.	Forms excellent masts and spars, deck, and other planking of vessels, and is largely used for house finishings. It works freely, and is one of the most useful timbers indigenous to New Zealand.	1	·578	36·07	212·80	·66	125	200	2·00			276·86	18·017	1 Good specimen; broke suddenly at last.—2 Do. do.—3 Good specimen: the fibres in tension broke square across.—4 Serrated fracture, after hanging a few seconds. 5 Broken by gradually increasing pressure.
			2	·575	35·84	261·50	·42	100	198	2·24			276·34	18·007	
			3	·633	39·47	186·10	·56	100	175	2·00			247·57	13·773	
			4	·579	36·08	183·70	·54	100	175	1·80			258·92	15·755	
			5						150	1·60					
			M	·591	37·11	211·0	·545	106	179·6	1·93	3·54	·590	264·92	16·388	*Mean results.*

No.	NAME, &c.	DIMENSIONS AND USES.	No.	S. G.	W	E.	δ	W'.	S.	δ'	$\frac{\delta'}{\delta.}$	$\frac{W'}{S}$	λ	W''	REMARKS.
26	Kauri— (Waved variety) Auckland		1						57	·60					Broken by gradually increasing pressure. This variety of Kauri is very ornamental, but the 'wave' in the grain, while adding much to the beauty of the wood, greatly diminishes its strength; though experiments on larger samples would probably give much higher results. Wood with this peculiarity would not be selected for ordinary work, so I have omitted their results in the general average.
			2	·660	41·14				56	·96			137·17	4·14	
			3	·700	43·66				56	1·10			134·87	3·94	
			4	·652	40·63				43				120·96	3·24	
			5	·683	42·56				27	·60			93·65	1·90	
			M	·674	42·0				47·8	·815			121·66	3·305	*Mean results.*
*	Kauri		1, 2, 3	·674	42·0	145·02	·61	90	119·1	1·24	2·03	·84	197·97	8·54	Average results of three experiments at Sydney. Two specimens 1·9 in. square, the third 1·9 in. broad and 3 ins. deep; all 5 feet long between supports.
	Kauri		GM	·623	38·96	181·27	·56	97	165·5	1·78	3·18	·586	241·91	13·552	*General mean* of all experiments on Kauri (omitting No. 26 as exceptional).
	„		GM	·638	38·96			130·88	1·54				192·62	10·624	*General mean* of all experiments on Kauri (including No. 26).
*	REWA REWA— Rewa Rewa *Knightia excelsa*	A lofty slender tree. Wood mottled red and brown, handsome and peculiar looking. Used for furniture and shingles.	1, 2	·788	49·11	247·38	·44	109	173	1·08	2·45	·632	221·0	9·839	Mean of two experiments at Sydney,—said to have been good samples, and to have given fair warning. Dimensions, 1·9" × 1·9" × 60".
27	Rewa Rewa— Wellington.		1	·809	50·40	177·6	·60	100	160	2·00			214·37	8·727	1 Broke very suddenly, with a short fracture.—2 Carried last weight about three minutes, slowly yielding.—3 Fair sample.
			2	·754	46·97	139·0	·52	75	150	1·60			210·11	9·094	
			3	·788	49·03	165·0	·46	75	150	1·50			205·66	8·527	
			M	·784	48·80	160·5	·53	83	153	1·7	3·20	·546	210·05	8 788	*Mean results.*
			GM	·785	48·92	195·25	·49	93	161	1·45	2·90	·580	214·43	9·205	*General mean* of all experiments on Rewa Rewa.

28	TOWAI— Red Birch *Fagus Menziesii* Wakatipu district, Otago,	A lofty tree attaining a diameter of two to three feet. Durable and adapted for mast making and oars, and for cabinet and cooper work. Promises to be one of the most useful timbers in the country, but has been little used hitherto, as it is found only in the interior in any quantity.	1						177	1·9					1 Broken by gradually increasing pressure.—2 Broke with little warning, after carrying the last weight one minute. 3, 4, 5, 6 Fair specimens; all broke suddenly. 7 Elasticity very early injured. 8 Very flexible—would scarcely break; fibrous.
			2	·632	39·36	130·0	·64	75	167	2·0			229	11·86	
			3	·602	37·50	[illegible]	·64	75	160	2·6			243	13·60	
			4	·604	37·65	152·0	·72	100	160	2·3			236	13·52	
			5	·641	39·95	105·6	·70	75	155	2·9			232	11·98	
			6	·624	38·86	115·3	·64	75	154	2·6			234	12·41	
			7	·653	40·78	87·0	·50	40	153	2·6			227	11·47	
			8	·624	38·86	106·5	·72	75	140	3·5			223	11·77	
			M	626	38·99	116	·65	73·6	158·2	2·55	3·92	·465	233·4	12·37	*Mean results.*
29	RIMU. Red Pine (*Dacrydium cupressimum*). Wellington.	50 to 80 feet high; 2 to 5 feet diameter. A valuable timber, much used for joisting and planking of public works in Otago, and for general building purposes. The old wood is handsomely marked, and is used for cabinet work.	1	·607	37·86	179·6	·56	100	184	2·64			259·20	15·415	1, 2, 3 Sudden long diagonal fractures.
			2	·613	38·20	174·1	·64	100	171	2·60			248·76	14·135	
			3	·607	37·86	169·6	·66	100	149	2·20			233·25	12·488	
			M	·609	37·97	174·4	·62	106	168	2·48	4·0	·595	247·07	14·011	*Mean results.*
30	RUINO. (Supposed Red Pine), Hawke's Bay.		1						178						1 Broken by a gradually increasing pressure. 2, 3, 4, 5 All broke suddenly, or at least with little warning. Neutral axis very low.
			2	·626	39·0	166·6	·64	100	170	2·0			245·48	13·622	
			3	·644	40·11	140·7	·70	100	170	2·40			242·04	13·058	
			4	·564	35·19	129·0	·78	100	152	1·80			244·38	14·213	
			5	·581	36·21	107·92	·70	75	145	2·56			235·26	12·984	
			M	·604	37·63	136·07	·705	94	163	2·19	3·11	·577	241·79	13·469	*Mean results.*
*	Rimu.		1, 2, 3	·576	35·88	147·56	·654	93·5	128	1·33	2·03	·73	222·05	11·62	*Mean results* of three experiments at Sydney. Samples all 5 feet long between supports; two 1·9 in. square, and the third 1·9″ × 3″ deep.
31	Rimu. Flagstaff, Dunedin.		1	·574	35·743	120·2	·82	100	149·0	2·5			239·96	13·592	All broke suddenly, No. 3 by a gradually increasing pressure. These specimens were cut from a plank exhibited for its beauty; so that the results are under the true strength of the wood, the plank having been cut so as to have a cross and wavy grain.
			2	·550	34·28	138·5	·80	100	112·0	1·00			212·51	10·888	
			3						109·2	0·90					
			4	·618	38·51	125·0	·60	75	95·0	1·00			184·66	7·757	
			5	587	36·60	113·6	·44	50	75·0	0·70			168·31	6·610	
			M	·582	36·28	124·3	·66	81·2	108·04	1·25	1·89	·75	201·36	9·62	*Mean results.*

No.	NAME, &c.	DIMENSIONS AND USES.	No.	S. G.	W.	E.	δ	W'	S.	δ'	$\frac{\delta'}{\delta}$	$\frac{W'}{\delta}$	λ	W''	REMARKS.
32	**RED PINE.** Banks' Peninsula, Canterbury.		1	·771	48·41	80·0	·50	40	75	·88			146·34	4·345	This wood resembled Black Pine, in colour and general appearance, more than Red Pine. The slabs were large and very handsome, but the grain was much too cross to give good results from experiments on such small samples. They all broke nearly square across, without noise. No. 5 broken by gradually increasing pressure.
			2	·829	51·70	100	·50	50	75	·90			141·61	3·937	
			3	·721	44·94				67	·88			143·56	4·340	
			4	·711	44·31	87·5	·40	35	58	·86			134·51	3·539	
			5						55	·60					
			M	·76	47·34	89·16	·46	42	66	·84	1·84	·636	141·50	4·04	*Mean results.*
			G M	·593	36·94	143·38	·663	92·8	140·2	1·76	2·65	·662	227·14	12·089	*General mean* of all experiments on Rimu, omitting No. 32.
			G M	·630	39·25	133·8	·654	86·3	122·5	1·53	2·34	·704	208·11	10·300	*General mean* of all experiments on Rimu, including No. 32.
*	**MANGI.** Mangi (*Tetranthera calicaris*).	A small evergreen tree.	1, 2	·621	38·70	185·36	·59	109	137·8	1·27	2·15	·796	221·86	11·17	*Mean* of two experiments at Sydney. Samples and fracture good. Specimens 5 feet long and 1·9 in. square.
33	**TOTARA.** Totara (*Podocarpus Totara*). Hawke's Bay.	40 to 60 feet in height, 4 to 10 feet in diameter; wood very durable, and adapted for every kind of carpenter work. It is considered to drive better (for piles) than perhaps any other New Zealand wood. Red Totara is highly esteemed in the North Island. It is extensively used in Wellington for house-building and for wharf piles. In Auckland the Harbour Master considers it proof against marine worms, if driven as soon as felled. The bark is used for roofing.	1						170·0	3·00					Nos. 1 and 6 were broken by gradually increasing pressure. All the samples showed great flexibility combined with considerable strength; but when they broke it was completely, and without any warning.
			2	·539	33·60	140·2	·56	75	150	2·58			248·43	15·08	
			3	·550	34·28	96·2	·76	75	148	3·28			244·28	14·39	
			4	·550	34·28	107·4	·59	60	140	2·60			237·59	13·61	
			5	·551	34·37	112·0	·68	75	140	3·00			237·30	13·56	
			6						140	2·40					
			M	·548	34·13	113·95	·65	71	148	2·81	4·32	·480	241·90	14·148	*Mean results.*
34	Totara. Wellington.		1	·547	34·11	155·2	·44	75	150	1·38			246·57	14·69	
			2	·532	33·18	250	·30	75	145	1·96			246·54	14·89	
			3	·534	33·26	96·1	·52	50	125	2·06			227·95	12·72	
			M	·538	33·83	168·8	·42	66	140	1·80	4·3	·471	240·35	14·083	*Mean results.*

35	Totara, Banks' Peninsula, Canterbury.		1	·569	35·46	102·0	·72	75	125	2·20			220·76	11·55	
			2	·559	34·77	103·5	·70	75	122	2·70			220·24	11·61	
			3	·561	34·97	80.6	·90	75	120	3·36			218·24	11·39	
			4	·633	39·43	96·87	·80	75	120	2·36			205·11	9·45	
			5						120	2·40					
			M	·565	36·16	95·74	·78	75	121·4	2·60	3·34	·618	216·09	11·00	*Mean results.*
*	Totara.		1 2 3	·587	36·58	188·12	·71	98	118·7	1·18	1·60	·826	207·01	10·51	*Mean results* of three experiments at Sydney. Specimens all 5 feet long between supports; two 1·9 in. square, and the third 1·9 broad × 3 ins. deep.
	Totara.		GM	·559	35·17	124·61	·65	77	133·6	2 27	3·50	·576	226·71	12·455	*General mean* of all experiments on Totara,
*	HINAU. POKAKO, (Hector). Hinau (*Elæocarpus dentatus*).	Small tree, the wood a yellowish brown colour, and close grained. The bark is used for tanning, and yields a permanent dye.	1 2	·562	35·03	200·7	·47	94	125	1·28	2 71	·754	220·10	11·766	*Mean* of two experiments at Sydney. Specimens 1·9 in. square and 5 ft. long between supports. Captain Ward remarks that this wood has very little power of resisting compression, and that it "bent like a rope round the point where the strain was applied:" from which I would rather infer that it has great power of *elongation*, there being nothing in that inconsistent with ability to resist compression.
36	MOKO. Moko (*Aristotelia racemosa*). Vicinity of Dunedin.	A small handsome tree, 6 to 20 feet high. Wood white and soft, and might be applied to the same uses as Lime tree in Britain. From some specimens finely marked veneers can be cut.	1						150	3·9					Very flexible wood.
			2	·530	33·04	83·30	·90	75	124	3·2			227·77	12·741	All broke somewhat suddenly. This wood appears to resist compression well, but breaks short under tension.
			3	·553	34·47	86·77	·60	50	123·7	3·18			222·74	11·930	
			4						122	3·60					
			5	·507	31·62	107·47	·74	75	120	3·40			229·07	13·175	Nos. 1 and 4 were broken by a gradually increasing pressure.
			6	·541	33·74				120	2·80			221·75	11·950	
			7	·566	35·25	93·75	·64	50	99	2·5			197·04	9·230	E and δ for No. 6 not noted.
			M	·593	33·62	93·07	·72	62	122	3·22	4·47	·508	219·67	11·805	*Mean results.*
37	WAWAKU. Supposed to be Kawaka *Libocedrus Doniana* Wellington.	60 to 100 feet high, 2 to 4 feet diameter. Wood close-grained and durable, and said to be excellent for planks and spars.	1	·637	39·69	136·7	·64	75	120	3·7	5·78	·625	229·38	9·364	Exceedingly flexible. Bent from the upper edge with great buckling of the fibres, under compression.

No.	NAME, &c.	DIMENSIONS, USES, &c.	No.	S. G.	W.	E.	δ	W'.	S.	δ'	$\frac{\delta'}{\delta}$.	$\frac{W'}{S}$	λ	W''	REMARKS.
	KOHE KOHE. (*Dysoxylum spectabile*).	40 to 50 feet high. Tough, but splits freely.	1 } 2 }	·678	42·25	208·61	·44	92	117·4	·99	2·25	·783	195·96	8·339	*Mean* of two experiments at Sydney Mint. Dimensions, 1.9 in. square and 5 ft. long between supports. Specimens said to have been worm eaten.
*	TARAIRE. (*Nesodaphne Tarairi*)	60 to 80 feet high. Wood white, splits freely, but not much valued.	1 } 2 }	·888	55·34	205·04	·47	99·6	112·3	·67	1.42	·895	167.49	5·322	*Mean* of two experiments at Sydney. Dimensions same as last. One sample broke at a flaw.
38	KAHIKATEA. White Pine (*Podocarpus dacrydioides*). Wellington.	Trees gregarious. 150 feet high, 4 feet diameter. Wood white or yellowish white; not durable. Would answer for building small boats, and is used for common cheap work and for ordinary building purposes.	1	·536	33·40	167	·44	75	155	2.0			253·29	15·671	} All broke suddenly.
			2	·557	34·74	147	·34	50	150	2.0			244·30	14·295	
			3	·463	28·86	167·4	·48	75	125	2·96			244·69	15·734	
			4	·468	29·17	139·0	·36	50	115	2·40			233·47	14·248	
			M	·506	31·54	155·1	·405	62	136	2·34	5·77	·456	243·94	14·987	*Mean results.*
		Sometimes used by cabinet makers as a contrast to darker woods, selected pieces being very handsome, and having a sparkling appearance when polished.													
39	WHITE PINE. Banks' Peninsula, Canterbury.		1						125	2·40					Nos. 1 and 5 broken by a gradually increasing pressure. Nos. 2 and 6, elasticity early damaged; δ not noted. All broke suddenly, No. 4 being the most fibrous specimen.
			2	·464	28·94				95	2·40			213·02	11·907	
			3	·459	28·63	83	·60	50	90	2·20			208·47	11·467	
			4	·474	29·54	78	·64	50	90	1·84			203·10	10·930	
			5						90	1·20					
			6	·470	29·33				55				161·05	6·763	
			M	·467	29·11	80·5	·62	50	90·8	2·01	3·24	·550	221·41	10·276	*Mean results.*
*	KAHIKA. (Supposed White Pine).		1	·502	31·28	108·54	·528	57·3	77·5	Not obsvd.		·739	185·07	8·645	*Results* of an experiment at Sydney. Sample, 1.9 in. square and 5 ft. long between supports.
	White Pine.			·488	30·43	127·1	·484	57·9	106	2·1[illegible]	4·46	·546	227·88	11·966	*General mean* of all experiments on White Pine.
40	WHAU. Native Cork Wood. (*Entelea arborescens*). Auckland.	A small tree with remarkably light wood.	1	·189	11·76	41·03	·34	13	82	4·0[illegible]	11·8	·406	193.98	15·493	These results are given more

In transverse section it appears as if it were formed of exceedingly thin tubes of woody fibre, the interstices (sometimes ½ inch wide, or even more) being filled with cellular tissue. When cut plank-wise and carefully smoothed with glass-paper, it presents all the appearance of a solid wood. It is used by the natives for fishing floats, but would be well adapted for life-belts, fenders for life-boats, and similar purposes, if painted or prevented from becoming waterlogged by occasional drying. It would answer for many purposes where little strength is required and great lightness an advantage, as, for instance, for rollers for the protection of plans and photographs, &c., when transmitted by post.

from their curiosity than from their usefulness. δ' is only approximate, as the specimen continued slowly yielding with the least weight, but never actually gave way. The specific gravity of the specimen tested was rather above the average of all which were weighed. The mean weight per cubic foot was 10.39 lbs., but one specimen weighed only 8.29 lbs., or a little more than half the weight of cork.

Notes.—The experiments made at Dunedin are distinguished by consecutive numbers as before.
The results marked with a † are reduced from a "Report of further Experiments conducted at the Sydney Branch of the Royal Mint, to determine the strength and elasticity of Colonial Timber," by E. W. Ward, Esq., Deputy-Master, 1860–61.
Those marked with †† are reduced from the results of the experiments conducted at the Paris Exhibition of 1855, by Captain Fowke, R.E.

No.	NAME, &c.	DIMENSIONS, USES, &c.	No.	S. G.	W.	E.	δ	W′	S.	δ'	$\frac{\delta'}{\delta}$	$\frac{W'}{S}$	λ	W″	REMARKS.
††	IRON BARK—	Has a high reputation for strength and durability. Diameter, 3 to 6 feet; height 100 to 150 feet.	1, 2, 3, 4	1·032	64·315	317·2			339				269·93	12·825	*Mean of results* of experiments at Paris in 1855, conducted by Capt. Fowke, R.E. The Paris experiments were all made on samples 2 in. square and 1 ft. between supports; any which did not agree with those standard dimensions being reduced thereto by calculation.
41	BARREMMA. Iron Bark. (*Eucalyptus sp.*) Jervis Bay.	Attains a diameter of 4½ to 5 feet, but that chiefly used does not exceed 4 feet diameter, as the heart of the tree generally decays before it attains that size.	1	1.238	77·14	319·6	·74	225	335	2·0			248·64	9·937	1 Very fine specimen; broken slowly; fibres much compressed on under side.—
			2	1·238	77·14	269·7	·54	150	325	2·40			241·38	9·361	2 Very tough and hard.—
			3	1·251	77·97	317·8	·68	200	325	1·80			240·04	9·212	3 Similar to the other.
		Thrives well on stiff clay soil. Is chiefly used for railway works, ship-building, &c., &c.	M	1·242	77·41	302·2	·65	185	328·3	2·07	3·18	·557	243·34	9·503	*Mean Results.*
†	IRON BARK. Berrima. Albury.	Timber hard, close-grained, and of great strength and durability. Is valuable for ship-building, engineering works, &c. It is, however, readily attacked by the white ant. (I understand that the Teredo attacks it freely at Newcastle, N.S.W.—J.M.B.)	1, 2, 3, 4, 5, 6	1·156	72·04	281·11	·63	177	222·5	1·18	1·88	·785	206·63	7·102	*Mean* of 6 experiments at Sydney: 3 on specimens from Berrima, and 3 on specimens from Albury. All the experiments at Sydney Mint were made on samples 2 in. square and 4 ft. long between supports.
	Ditto.		GM	1·138	70·92	297·08	·64	180	282·7	1·47	2·3	·636	234·58	9·417	*General mean* of all experiments on Iron Bark.
42	BOOAH. Colonial Mahogany. (*Eucalyptus sp.*) Brisbane Water.	Grows to a great size. Is often used as principal timbers in house building, &c., as when varnished it matches well with cedar.	1						320	1·60					1 Broken by a gradually increasing pressure.—
			2	1·108	69·06	361·10	·66	225	300	1·20			245.04	10·202	2 Gave way slowly at first; very fibrous.—
			3	1·111	64·26	321·80	·64	200	300	1·10			244·71	10·160	3 Broke slowly, fibre by fibre.—
		Generally found in the same forest as Black Butt and Blue Gum.	4	1·084	67·54	288·18	·88	225	295	1·40			245·72	10·372	4 Good specimen.
			M	1·101	68·62	323·69	·73	216	303·7	1·36	1·86	·711	245·14	10·245	*Mean results.*

No.	NAME, &c.	DIMENSIONS, USES, &c.	No.	S. G.	W.	E.	δ	W'	S.	δ'	$\frac{\delta'}{\delta}$	$\frac{W'}{S}$	λ	W''	REMARKS.
†	MAHOGANY. Bowenfels.	Strong timber, said to be durable and very suitable for house carpentry.	1 2 3 4	1·036	64·56	276·91	·57	159	206	·98	1·72	·771	210·28	7·769	Sydney experiments; mean of four.
††	Mahogany.	Diameter, 30 to 70 inches; height, 60 to 130 feet. Much prized for strength and durability.	1 2 3	·952	59·33	391·23			281				255·88	12·00	Paris experiments; mean of three.
	Ditto.		M	1·037	64·21	325·24	·64	183	262	1·17	1·82	·70	234·42	9·781	*Mean* of all experiments on Mahogany.
43	YARR WARRA. Black Butt. (*Eucalyptus media.*) Brisbane Water.	Grows larger than Iron Bark, but when large the heart is generally decayed. Greatly used for almost all kinds of work; is much used for flooring boards, as it wears exceedingly well.	1						297	1·70					1 Broken by a gradually increasing pressure.—2, 3, and 4, broke slowly and quietly; a good fibrous fracture.
			2	1·004	62·54	249·7	·68	175	285	2·04			250·99	11·245	
			3	1·009	62·88	262·73	·82	200	275	1·59			245·87	10·762	
			4	1·015	63·23	278·04	·62	175	275	1·70			245·20	10·674	
			M	1·009	62·88	263·49	·71	183	283	1·73	2·44	·646	247·35	10·894	*Mean results.*
†	BLACK BUTT. Brisbane.	Used for posts, rails, piles, &c. Supposed not to be very durable.	M	·945	58·89	316·8	·47	148	185·5	·74	1·57	·798	208·67	8·011	*Mean of four*; Sydney experiments.
††	Black Butt.	One of the largest of the Eucalypti, producing excellent timber for house carpentry, or any purpose for which strength and durability are the chief requisites; sometimes attains a diameter of 10 feet and upwards, but in such cases is always very hollow.	M	·891	55·53	279·82			273·2				260·79	12·884	*Mean of eight*; Paris experiments.
	Black Butt.		G M	·929	57·90	293·95	·57	163	253·7	1·23	2·16	·642	244·20	11·186	*General mean* of 16 experiments on Black Butt.
44	DAHL WAH. Forest Oak (*Casuarina suberosa*, perhaps *C. tenuissima*). Lake Macquarie.	The best description is chiefly used for shingles, but large quantities are used for firewood and for making charcoal, though its qualities ought to command a better use.	1						325	1·60					1 Broken by a gradually increasing pressure.—2 and 3 Fracture moderately good and fibrous.—4 Sudden short fracture; very stiff specimen.
			2	1·125	70·085	273·35	·54	150	317	1·40			250·15	10·554	
			3	1·100	68·571	316·9	·70	200	275	1·20			235·46	9·452	
			4	1·045	65·142	315·7	·70	225	256	1·04			233·08	9·502	
			M	1·090	67·93	301·98	·65	192	293	1·31	2·02	·655	239·56	9·508	*Mean results.*
†	ForestOak (*C. suberosa*). Bowenfells.	Timber of fine mottled silvery grain, and of great strength and durability. Chiefly used for shingles.	M	1·104	68·80	286·63	·52	150	193·5	·78	1·5	·781	196·67	6·583	*Mean of four*; Sydney experiments.

	Forest Oak.		G M	1·098	68·43	293·21	·57	168	243	1·04	1·83	·691	215·05	7·834	*General mean* of all experiments on Forest Oak.
45	COORANGA. Blue Gum (*Eucalyptus sp.*) Brisbane.	Grows to a large size. Valuable timber, extensively used by wheelwrights, as well as for ship and general house building purposes. Generally found in the same forests as Iron Bark and Black Butt.	1	·990	61·714	238·6	·64	150	275	2·10			245·35	11·070	1 Gave way gradually; good fracture.—2 Broke suddenly; fibres compressed, or buckled considerably on under side.
			2	·993	61·857	290·3	·68	200	275	1·74			247·91	11·031	
			M	·991	61·785	264·4	·66	175	275	1·92	2·91	·636	246·63	11·050	*Mean results.*
††	TDJETLAT BARROUL-GOTRA. Blue Gum (*Eucalyptus sp.*) Camden.	Very valuable timber more in-locked in grain and more durable than common Blue Gum, but not obtainable of nearly such large size; one of the most durable woods known, excellent for naves and fellies of wheels, and for works underground. Average diameter 3 to 4 feet; average height 80 to 100 feet.	M	·843	52·54				224	·665			242·78	11·48	Paris experiments. *Mean of four.*
†	Blue Gum. Brisbane.		M	1·094	68·18	257·2	·66	169	210	1·17	1·74	·805	206·25	7·279	Sydney experiments. *Mean of four.*
46	Blue Gum.		M						210						*Mean* breaking weight of 12 samples, mostly cut from the cases in which the large blocks of Newcastle coal were sent to the Exhibition.
	Blue Gum.		G M	·973	60·66	259·6	·66	171	214·8	1·12	1·7		228·94	9·713	*General mean* of 22 experiments on Blue Gum.
†	SPOTTED GUM. *Eucalyptus goniocalyx.* Brisbane.	25 feet average height to fork; 30 inches average diameter. Timber of great strength and durability in dry situations, but not much prized.	M	1·170	72·91	332·5	·50	166	217	1·02	2·04	·765	202·84	6·802	Sydney experiments. *Mean* of 4 from Brisbane.
47	BOOANGIE Spotted Gum *Eucalyptus sp.* Brisbane Water.	Attains a very large size, sometimes as much as 8 feet diameter. Heart generally rotten. Used for bridge building, coach building, &c., &c. Grows well in a clay soil.	1	·985	61·371	214·03	·64	125	225	1·64			225·13	9·133	1, Hung a short time before parting. 2, Good fracture. 3, Broken by a gradually increasing pressure. 4, Broke quickly; fibrous.
			2	·990	61·714	184·64	·70	125	220	1·70			221·99	8·356	
			3						215	1·20					
			4	·974	60·685	167·06	·76	125	195	1·40			210·76	8·050	
			M	·983	61·26	188·58	·70	125	214	1·48	2·11	·584	219·29	8·68	*Mean results.*
†	Spotted Gum Berrima.	Tree with elongated trunk, averaging 40 feet to fork, and 2 feet diameter. Timber very strong, durable, and considered very suitable for ship building, &c.	M	·942	58·71	238·31	·58	138	172	1·04	1·79	·806	200·95	7·440	Sydney experiments. *Mean* of 4 from Berrima.
	Spotted Gum		G M	1·036	64·57	149·91	·58	144	201	1·18	2·03	·716	206·64	7·546	*General Mean* of 12 experiments on Spotted Gum.

No.	NAME, &c.	DIMENSIONS AND USES.	No.	S. G.	W.	E.	δ	W′	S.	δ'	$\frac{\delta'}{\delta}$	$\frac{W'}{S}$	λ	W″	REMARKS.
48	DTHAH DTHAANG Stringy Bark *Eucalyptus sp.* George's river.	The timber is not very highly prized, but the bark is turned to very many uses, such as for roofing, and as a substitute for rope. It is one of the most serviceable trees that grow for settlers and others.	1						250	2·50					1, Broken by continued gradually increasing pressure. 2, Short fracture. Broke at a flaw. 3, Hung one minute, and then broke without warning. 4, Short fracture: broke suddenly.
			2	·849	52·94	158·97	·60	100	224	2·00			241·84	11·348	
			3	·838	52·26	197·42	·56	100	200	1·80			230·02	10·332	
			4	·827	51·57	169·03	·62	100	175	1·40			216·59	9·220	
			M	·838	52·26	175·14	·59	100	212·2	1·93	3·27	·471	229·48	10·80	*Mean results.*
††	BOUR-BOUGNE Stringy Bark Camden.	Height 50 to 100 feet, 2 feet to 4 feet 6 inches diameter. Much prized for flooring and general house carpentry, and of considerable strength and durability.	M	·864	53·84				181				215.65	8·947	Paris experiments. *Mean* of 4 from Camden.
†	Stringy Bark From Berrima, Albury, Armidale, Mudgee	Valuable timbers used for ordinary engineering and house building purposes. The timber appears least esteemed in the Armidale district.	M	·980	61·10	201·42	·56	113	155	·91	1·162	·73	187·37	6·341	Sydney experiments. *Mean* of 12 samples from 4 districts.
	Stringy Bark		G M	·933	58·18	196·16	·566	110	171·6	1·16	2·05	·641	199.97	7·515	*General mean* of 20 experiments.
49	COORONG Mountain Pine *Araucaria Cunninghamii* Richmond River.	Grows to a very large size on high ground. Used for packing-cases, common furniture, cheap houses, building and similar purposes.	1	·666	41·48	287·6	·52	150	225	1·40			273·82	16·484	1, Hung one minute and then broke suddenly, without warning. 2, Broken by a gradually increasing pressure. 3, Short ragged fracture; little warning. 4, Like last
			2						195	2·00					
			3	·602	37·58	222·4	·64	125	175	1·36			253·70	14·822	
			4	·605	37·71	252·3	·40	100	175	1·10			253·27	14·746	
			M	·624	38·92	254·1	·52	125	192·5	1·46	2·81	·649	260·26	15·384	*Mean results.*
	Mountain Pine *Araucaria Cunninghamii* Brisbane.	Said to be of little value. Tree averages 45 feet to fork: 30 inches, diameter.	M	·763	47·55	220·2	·445	98	117·25	·76	1·71	·835	184·62	6·978	Sydney experiments. *Mean* of 4 from Brisbane.
	Mountain Pine		G M	·703	43·85	234·7	·48	109	154·8	1·11	2·31	·698	217 03	10·582	*General Mean* of 20 experiments on Mountain Pine.
50	POLAI Cedar *Cedrela Australis*	The Cedar attains a diameter of 10 to 18 feet, and is usually sound to the heart. It is a free-working, light timber, which in the colonies takes the place of mahogany: in fact, its uses are too numerous to be mentioned. The undergrowth of cedar scrub is of the densest character, rendering it necessary to cut tracks in it, in order to be able to get back to the starting point.	1						167	2·20					1, Broken by gradually increasing pressure.
			2	·474	29·56	144·4	·56	75	148	2·40			263·10	17·974	2, Broke suddenly.
			3	·489	30·51	160·5	·46	75	147	2·00			258·06	17·020	3, Do.
			4	·473	29·48	145·1	·72	100	140	2·00			256·20	17·065	4, Do. short across.
			M	·478	29·85	150·0	·58	88	150·5	2·15	3·70	·551	259·12	17·358	*Mean results.*
†	Cedar, Armidale		M	·444	28·12	122·80	·57	70	91·0	·98	1·72	·77	211·51	11·91	Sydney experiments. *Mean* of 4 from Armidale.
	Cedar		G M	·458	28·86	134·46	·574	74	120·75	1·565	2·72	618	231·91	14·248	*General mean* of all experiments on Cedar.

WOODS FROM TASMANIA.

No.	NAME, &c.	DIMENSIONS AND USES.	No.	S. G.	W.	E.	δ	W'.	S.	δ'	$\frac{\delta'}{\delta}$	$\frac{W'}{S.}$	λ	W''	REMARKS.
50	BLUE GUM— Believed to be Tasmanian		1	1·153	71·871	322·2	·38	125	317	1·06	2·79	3·94	246·93	10·153	A very fine well-seasoned sample, believed to be from Tasmania; cut from an old window sill.
51	BLUE GUM— *Eucalyptus Globulus.*	Diameter 5 to 30 feet—average of those felled for use, 6 feet; height, 150 to 350 feet; abundant in the southern and south-western parts of the island. A very superior timber, used for house-building, ship-building, &c.	1	1·047	65·30	263	·50	125	285	3·00			245·63	10·54	1, Fibrous fracture, neutral axis high. Lower fibres shew signs of great compression.
			2	·999	62·254	311	·46	125	273	1·80			247·48	10 954	2, Broke somewhat sharply with shorter fracture than usual.
			3	·995	62·030	362	·50	175	250	2·30			255·53	11·704	3, Gave good warning, neutral axis very high.
			M	1·014	63·19	312	·48	141	269	2·36	4·92	·524	249·53	11·066	*Mean results.*
52	BLUE GUM— *E. Globulus.*		1	1·071	66·73	212·8	·72	150	260	2·24			232·09	9·309	1, Sudden fracture—fibrous, but short.
			2	1·084	67·52	364·4	·48	150	250	1·68			226·20	8·790	2, After yielding a time, broke rather short.
			3						240	1·80					3, Broken by a gradually increasing steady pressure—
			4	1·084	67·52	202·3	·70	125	206	2·20			205·33	7·242	4, Broke diagonally.
			M	1·078	67·26	259·8	·63	142	239	1·98	3·14	·594	221·21	8·447	*Mean results.*
53	CURLED BLUE GUM—		1						140	1·62					Broken by a gradually increasing pressure.
			2	1·012	63·08				112	2·80			156·67	3·620	All the samples of Curled Blue Gum broke nearly square across, though tried in all positions of the grain. Obviously the "curl" extends over a considerable thickness, and larger samples would probably give much higher results, as the timber looks well in large pieces.
			3	·996	62·09				80	1·50			133·46	2·648	
			4	·992	61·80				78				132·09	3·130	
			5	·952	59·30				69	1·80			126·83	2·447	
			M	·988	61·57				95·8	1·93			187·26	2·961	*Mean results.*
			G M	1·061	66·17	291·1	·53	139	260	2·01	3·8	·534	237·02	9·818	*General mean* of 8 experiments on Blue Gum, excluding No. 53.

No.	NAME, &c.	DIMENSIONS, USES, &c.	No.	S. G.	W.	E.	δ	W'	S.	δ'	$\frac{\delta'}{\delta}$	$\frac{W'}{S}$	λ	W''	REMARKS.
	Curled Blue Gum		G M	1·085	64·5				196·8	1·98			200·74	8·230	*General mean* of 18 experiments on Blue Gum, including No. 53.
54	IRON WOOD—*Notelaria ligustrina*	Diameter 9 to 18 inches, not rare, used for mallets, sheaves of blocks, turnery, &c.	1	1·089	67·88	243·1	·52	125	295	2·40			245·10	10·298	1, Broke quickly, with fibrous fracture.—2, After hanging one minute, splintered up slowly.
			2	·998	62·27	209·1	·60	100	225	2 70			230·53	9·508	
			M	1·043	65·07	226·1	·56	112	260	2·55	4·55	·430	237·81	9·900	*Mean Results.*
55	PRICKLY BOX—*Bursaria spinosa, var.*	Diameter 8 to 12 inches, height 15 to 25 feet. Used for sheaves of blocks, and general turnery.	1	·968	60·34	252·5	·64	150	250	2·00			239·32	10·408	1. Broke slowly, with a short fracture.—2, Resists compression well; broke gently; more fibrous than last.
			2	·877	54·66	166·7	·58	100	225	2·56			238·55	10·867	
			M	·922	57·5	209·6	·61	125	237·5	2·28	3·70	·526	238·98	10·637	*Mean results.*
56	BLACKWOOD—*Acacia melanoxylon*	Diameter 1½ to 4 feet, average, about 2½ feet; height, 60 to 130 feet. Makes excellent naves and spokes for wheel work, cask staves, &c.	1						260	2·00					1, Broken by a gradually increasing pressure.—2, Hung 1 min., and then gave way slowly.—3, Fibres parted by jerks, one after another.—4, Broke suddenly at last.
			2	·924	51·57	222	·70	150	250	1·90			258·97	13·174	
			3	·754	46·97	220	·58	125	245	2·10			268·53	14·853	
			4	·721	44·92	260·1	·60	150	235	2·20			280·15	16·533	
			M	·800	47·82	234	·63	142	247·5	2·05	3·25	·574	269·22	14·187	*Mean results.*
57	BLACKWOOD—(*Figured var.*)	In constant use for cabinet and fancy work.	1	·781	48·69	233·3	·64	150	250	2·00			266·60	14·362	1 Broke very suddenly.—2 Broken by a gradually increasing pressure.—3 Broke very suddenly.—4 Broke with a loud noise, suddenly.—5 Similar to last, but more fibrous.
			2						230	2·60					
			3	·674	42·00	201·1	·64	125	225	2·60			272·18	16·132	
			4	·679	42·31	207·6	·80	150	200	1·80			255·62	14·180	
			5	·730	45·47	197·7	·64	125	200	1·70			246·58	12·730	
			M	·716	44·62	209·9	·68	137	221	2·14	3·15	·620	260·23	14·351	*Mean results.*
			G M	·752	45·99	218·8	·66	139	232·3	2·10	3·18	·597	264·08	14·281	*General Mean* of 9 experiments on Black Wood.
58	STRINGY BARK—*Eucalyptus gigantea*	Diameter 4 to 24 feet, average of those cut, about 5½ feet; height, 150 to 300 feet. Abundant everywhere upon hilly ground. Used for same purposes as Blue Gum.	1	·966	60·214	231	·70	150	224	2·10			226·77	9·360	1, Broke slowly, fibres on under side much compressed. 2, Ditto. 3, Broken by gradually increasing pressure. 4, Ditto.
			2	·983	58·157	245·5	·70	150	223	2·20			230·29	9·808	
			3						200	2·00					
			4	1·021	63·643	241·4	·58	125	175	1·24			194·97	6·727	
			M	·973	60·67	239·3	·66	142	205·5	1·88	2·85	·691	217·84	8·632	*Mean results.*

[CONTINUED.]

59	PINKWOOD— *Beyeria viscosa*	Diameter 6 to 10 inches, height 15 to 25 feet. Used for sheaves of blocks, turnery, &c,	1	·704	43·88	178·4	·56	100	195	2·20	3·93	·513	247·84	13·090	
60	NATIVE BOX— *Bursaria Spinosa*	Turnery, &c.	1	·848	52·46	209·2	·50	100	198	2·00			228·42	10·171	1, Sudden short fracture.
			2	·900	56·10	191·5	·54	100	180	2·30			210·61	8·360	2, Similar to last, but better.
			M	·871	54·28	200 3	·52	100	189	2·15	4·13	·529	219·51	9·265	*Mean results.*
61	MYRTLE— *Fagus Cunninghamii*	Diameter 2 to 9 feet, average about 3½ feet; height 60 to 180 feet. Abundant in western parts of the island, growing in forests to a great size in humid situations. Used for house fittings, ornamental cabinet, and fancy work.	1	·921	57·40	238·4	·64	150	275	2·00			257·35	12·341	1, Moderately fibrous fracture. 2, Broke very suddenly, resists compression well. 3, Short fracture. 4, Broken by gradually increasing pressure. 5, Broke quietly, through a curl or wave of the grain, nearly short across.
			2	·776	48·34	230	·44	100	200	1·80			239·15	11·613	
			3	·844	52·60	119·0	·42	50	175	1·60			214·46	8.953	
			4						140	1·40					
			5	·908	56·57	116·0	·40	50	115	1·60			167·63	5·276	
			M	·862	53·73	175·8	·47	87	181	1·73	3·68	·480	219·65	9·545	*Mean results.*
62	NATIVE LAUREL— *Anopterus glandulosus*	Diameter 6 to 10 inches, height 15 to 22 feet. Tolerably abundant in some sub-alpine localities. Used for cabinet and fancy work.	1	·770	48·80	153·3	·70	100	150	1·80			207·84	8·803	1, Hung upwards of one minute, when the outer part flew off. 2, Diagonal fracture. 3, Ditto.
			2	·742	46·28	108·0	·68	75	145	1·80			208·10	8·987	
			3	·737	45·94	94·3	·80	75	125	1·78			193·94	7·834	
			M	·750	47·0	118·5	·73	83	140	1·63	2·23	·593	203·29	8·541	*Mean results.*
63	HUON PINE— *Dacrydium Franklinii*	Three to 8 feet diameter, average 4½ feet; height 50 to 120 feet. Very durable.—Used for boat building, flooring, house fittings, &c.	1						163	2·20					1, Broken by gradually increasing pressure. 2, Very sudden short fracture. 3, Ditto, ditto. 4, After one minute, broke suddenly, no warning. 5, Very sudden short fracture.
			2	·512	31·88	99·80	·46	50	143	2·20			249·00	15·489	
			3	·539	33·60	96·88	·80	75	136	2·20			236·54	13·627	
			4	·512	31·88	99·98	·40	50	125	1·76			233·80	13·549	
			5	·582	36·26	87·80	·80	75	120	1·82			213·90	10·727	
			M	·536	33·4	96·11	·61	62	137·4	2·07	3·34	·451	233·06	13·098	*Mean results.*

APPENDIX C.—*TABLE No. II.—ABSTRACT TABLE,*

Showing the "Mean Results" for all the Woods experimented on, as well as the Values of a few of the Strongest and Weakest Woods experimented on at Paris in 1855, and of a few of the best-known British and other Woods, from Barlow's Standard Work on "Materials and Construction" (London, edit. of 1851). The whole arranged in the order of the values of S.

No.	Name of Wood.	Where Grown.	S.G.	W.	E.	δ.	W'	S.	δ'	$\frac{\delta'}{\delta}$	$\frac{W'}{S}$	λ	W''.	Remarks.
					$\frac{W'}{\delta}$									
				lbs.		*ins.*	*lbs.*	*lbs.*	*ins.*			*feet.*	*tons.*	
1	Iron Wood, or Red Wood	Jamaica, a small tree but 5 or 6 in. diameter, (*Brythroxylon areolatum.*)	·987	61·511				468·6				324·54	18·959	The strongest wood tested at Paris, 1855.
2	Box of Illawarra.	New South Wales (a large tree, *Eucalyptus* sp.)	1·17	72·915				432·2				286·25	13·547	Paris Experiments, 1855.
3	Black Heart Ebony.	Jamaica (*Brya ebenus*).	1·193	74·349				424·5				280·94	10·504	Do.
4	Green Heart.	British Guiana, squares to 18 to 24" and 60 to 70 ft. long. (*Nectandra rodiæi.*)	1·052	65·56				381·66				288·68	14·081	Do., from Masarimi River.
5	Black Maire.	North Island, N.Z.	1·159	72·29	273·0	·78	198	314·2	2·02	2·77	·614	244·90	10·014	New Zealand Experiments, 1865.
6	Iron Bark.	New South Wales.	1·188	70·92	297·08	·64	180	282·7	1·47	2·3	·636	234·58	9·417	Paris, N.S.W. & N.Z. Experiments.
7	Native Mahogany.	Do	1·037	64·21	325·24	·64	183	262	1·17	1·82	·70	234.42	9·781	Do. do. do.
8	Blue Gum.	Tasmania.	1·061	66·17	291·1	·58	139	260	2.01	3·8	·534	237·02	9·813	N.Z. experiments, omitting the results of the curled variety, which are much too low.
9	Iron Wood.	Do.	1·043	65·07	226·1	·56	112	260	2·55	4·55	·430	237·81	9.900	Do.
10	Black Butt.	New South Wales.	·929	57·90	293·95	·57	163	253·7	1·23	2·16	·642	244·20	11·186	Paris. N.S.W. & N.Z. Experiments.
11	Titoki.	New Zealand.	·916	57·10	229	·51	116	248	2·73	5·35	·468	245·03	11·22	New Zealand Experiments.
12	Black Mapau.	Do.	·965	60·14	215·2	·58	125	243	2·13	3·67	·514	231·76	9·872	Do.
13	Forest Oak.	New South Wales.	1·098	68·48	293·21	·57	168	243	1·04	1·83	·691	215·05	7·834	N.S.W. and N.Z. Experiments.
14	Manuka.	New Zealand.	·943	59·0	239·5	·49	115	239	2.05	4·43	·482	234·52	10·224	Do. do.
15	Prickly Box.	Tasmania.	·922	57·5	209·6	·61	125	237·5	2.28	3·70	·526	238·93	10·637	New Zealand do.
16	Black Wood.	Do.	·752	45·99	218·8	·66	139	232·8	2·10	3·18	·597	264·08	14·281	Do. do.
17	Green Heart.	British Guiana.	1·00	62·32	192·16			229·9				225·83	9·12	From Barlow's work—wood came from Berbice.
18	Blue Gum.	New South Wales.	·973	60·66	259·6	·66	171	214·8	1·12	1·7		228·94	9·713	Paris, N.S.W. & N.Z. Experiments.

19	Kowai.	New Zealand.	·884	55·11	198·05	·584	98	207·5	2·62	4·82	·487	227·97	10·236	New Zealand Experiments.
20	Tawa.	Do.	·761	47·45	203·47	·68	142·4	205·5	1·65	2·49	·711	240·39	12·204	Do. and N.S.W. do.
21	Stringy Bark.	Tasmania.	·973	60·67	239·3	·66	142	205·5	1·88	2·85	·691	217·34	8·632	New Zealand do.
22	Teak.	?	·745	46·43	349·3	·188	65·67	205·17	·705	3·75	·32	247·16	12·656	From Barlow's work.
23	Towai (Black Birch).	New Zealand.	·78	48·62	219·5	·503	108·8	202·5	2·32	4·32	·56	239·20	11·936	N.S.W. and N.Z. Experiments.
24	Spotted Gum.	New South Wales.	1·036	64·57	149·91	·58	144	201	1·18	2·03	·716	206·64	7·546	Do. do. do.
25	Miro.	New Zealand.	·787	49·07	230·24	·603	133	197·2	1·54	2·51	·675	238·20	11·777	Do. do. do.
26	Blue Gum.*	Tasmania.	1·035	64·5				196·8	1·98			200·74	8·230	New Zealand experiments, including the results of the curled variety.
27	Rata (Iron Wood).	New Zealand.	1·045	65·13	244·2	·51	93	196	2·08	4·18	·50	202·68	7·274	N.S.W. and N.Z. Experiments.
28	Pink Wood.	Tasmania.	·704	43·88	178·4	·56	100	195	2·20	3·93	·513	247·84	13·090	New Zealand do.
29	Red Mapau.	New Zealand.	·991	61·82	169·88	·57	92	192·4	2·07	3·63	·504	199·6	7·184	N.S.W. and N.Z. do.
30	Matai (Black Pine).	Do.	·658	40·74	156·22	·67	103	190	2·08	3·10	·542	245·51	13·257	Do. do. do.
31	Native Box.	Tasmania.	·871	54·28	200·3	·52	100	189	2·15	4·13	·529	219·51	9·265	New Zealand do.
32	Native Myrtle.	Do.	·862	53·73	175·8	·47	87	181	1·73	3·68	·480	219·65	9·545	Do. do.
33	Maire.	New Zealand.	·790	49·24	177·2	·64	106	179·7	1·82	2·84	·590	224·63	10·331	Do. do.
34	OAK.	Britain.	·752	46·87	111·31			178·66				229·56	10·868	From Barlow's Work. Mean of two best samples which had been years in store.
35	White Mapau.	New Zealand.	·822	51·24	166·86	·54	80	177·6	3·25	6·0	·450	210·53	8·780	New Zealand Experiments.
36	Stringy Bark.	New South Wales.	·933	58·18	196·16	·566	110	171·6	1·16	2·05	·641	199·97	7·515	Paris, New South Wales, and New Zealand Experiments.
37	ASH.	Britain.	·741	46·195	180·07			169·2				225·02	10·517	From Barlow's work.
38	Kauri.	New Zealand.	·623	38·96	181·27	·56	97	165·5	1·78	3·18	·586	241·91	13·552	New South Wales and New Zealand Experiments, omitting the results of the "waved" variety, which is only an ornamental wood.
39	Rewa Rewa.	Do.	·785	48·92	195·25	·49	93	161	1·45	2·90	·580	214·43	9·205	N.S.W and N. Z. Experiments.
40	Red Birch.	Do.	·626	38·99	116	·65	73·6	158·2	2·55	3·92	·465	233·4	12·37	New Zealand Experiments.
41	Mountain Pine.	New South Wales.	·703	43·85	234·7	·48	109	154·8	1·11	2·31	·698	217·03	10·582	New South Wales & N. Z. do.
52	MEMEL DEAL.	Russia.	·59	36·77	116			144·25				232·88	12·625	From Barlow's work.
43	Rimu (Red Pine).	New Zealand.	·563	36·94	143·38	·663	92·8	140·2	1·76	2·65	·662	227·14	12·089	New South Wales and New Zealand Experiments, omitting the results of the experiments on the wood from Banks' Peninsula, which was very cross-grained and merely ornamental.
44	Native Laurel.	Tasmania.	·750	47·0	118·5	·73	83	140	1·63	2·23	·593	203·29	8·541	New Zealand Experiments.
45	Mangi.	New Zealand.	·621	38·70	185·36	·59	109	137·8	1·27	2·15	·796	221·86	11·17	New South Wales do.
46	Huon Pine.	Tasmania.	·536	33·4	96·11	·61	62	137·4	2·07	3·34	·451	233·06	13·098	New Zealand do.
47	Totara.	New Zealand.	·559	35·17	124·61	·65	77	133·6	2·27	3·50	·576	226·71	12·455	N. S. W. and New Zealand do.

APPENDIX C.—*ABSTRACT TABLE*—(*Continued.*)

No.	Name of Wood.	Where Grown.	S.G.	W.	E.	S.	W′	S.	δ′.	$\frac{\delta'}{\delta}$.	$\frac{W'}{S}$.	λ	W″	Remarks.
				lbs.	$\frac{W'}{\delta}$.	ins.	lbs.	lbs.	ins.			feet.	tons.	
48	Kauri.*	New Zealand.	·638	38·96				130·88	1·54			192·62	10·624	New South Wales and New Zealand Experiments including the cross-grained specimens.
49	BEACH.	Britain.	·696	43·37	195·83	·168	32·8	129·66	·936	5·57	·253	203·3	8·839	From Barlow's work.
50	OAK.	Do.	·898	55·96	127·01			128·55				178·20	5·993	Do. do, mean of all the tabulated Experiments on Oak.
51	Hinau.	New Zealand.	·562	35·03	200·7	·47	94	125	1·28	2·71	·754	220·10	11.766	New South Wales Experiments.
52	Rimu.*	Do.	·630	39·25	133·8	·654	86·3	122·5	1.53	2·34	·704	208·11	10·300	New South Wales and New Zealand Experiments, including the cross-grained specimens.
53	Moko.	Do.	·593	33·62	93·07	·72	62	122	3·22	4·47	·508	219·67	11·805	New Zealand Experiments.
54	Cedar.	New South Wales.	·458	28·86	134·46	·574	74	120·75	1·565	2·72	·613	231·91	14·243	N.S.W. and New Zealand do.
55	Kawaka.	New Zealand.	·637	39·69	136·7	·64	75	120	3·7	5·78	·625	229·38	9·364	New Zealand do.
56	Kohe Kohe.	Do.	·678	42·25	208·61	·44	92	117·4	0·99	2·25	·783	195·96	8·339	New South Wales do.
57	Bitter-wood.	Jamaica (*Quassia excelsa*). Valuable for house work, as it is never infested with insects.	·555	34·59				117				216·24	11·225	Paris Experiments.
58	Taraire.	New Zealand.	·888	55·34	205·04	·47	99·6	112·3	·67	1·42	·895	167·49	5·322	New South Wales do.
59	White Pine (Kahikatea).	Do.	·488	30·43	127·1	·484	57·9	106	2·16	4·46	·546	227·38	11·966	N.S.W. and New Zealand do.
60	Cedar.	Jamaica (*Cedrela odorata*). Large tree, much esteemed for cabinet & house work.	·576	35·898				99·94				196·18	9·068	Paris do.
61	Riga Fir.	Russia.	·745	46·46	167·77	·169	27·8	89·96	1·15	6·80	·308	163·59	5·543	From Barlow's work.
62	ELM.	Britain.	·549	34·21	82·22			87·92				188·48	8·575	Do.
63	Yacca.	Jamaica (*Podocarpus yacca*). Used for ornamental cabinet work.	·626	39·01				68·9				154·46	5·518	The weakest wood tested at Paris.
64	Whau (Corkwood).	New Zealand.	·189	11·76	41·03	·34	13	32·0	4·00	11·8	·406	193·98	15·493	New Zealand Experiments.

* Nos. 26, 48, and 52 ought not to be taken as the values of the respective woods, as the results are rendered too-low by the low values of the cross-grained varieties. Nos. 5, 38, and 42 are more fair averages respectively.

APPENDIX C.

TABLE III.—Exhibiting the Number of Years to be assigned to the different descriptions of COLONIAL TIMBER now in use for Ship-Building: the same to be of good quality, properly seasoned, and free from defects.

No.	Names.	Timbering.									Rudder & Windlass Main Pieces	Outside Planking.					Inside Planking.			No.
		Floors.	First Futtocks.	Second Futtocks.	Third Futtocks and Top Timbers.	Main and Rider Keelsons.	Stem and Stern Posts.	Transoms, Knight-heads, Hawse Timbers, Apron, Deadwood.	Beams and Hooks.	Knees.		Keel to First Futtock-heads.	First Futtock-heads to Light water-mark.	Light-water mark to Wales.	Wales, Top-sides, and Sheer Strakes.	Upper-deck Water-ways, Spirketting, and Plank-sheers.	Limber and Bilge Strakes, and Ceiling between.	Ceiling from Bilge to Deck-clamps or Stringer.	Shelf-pieces, Clamp and Lower-deck Water-ways.	
1	Red Gum, Flooded Gum, Blackwood, Box, Iron Bark, Swan River Mahogany ...	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	1
2	Blue Gum	10	10	10	9	10	9	9	10	9	9	12	12	8	8	8	9	9	9	2
3	Grey Gum	10	10	10	9	9	7	7	7	—	—	12	12	8	8	7	9	9	9	3
4	Messmate	10	10	10	9	10	7	7	9	—	—	12	12	8	8	7	9	9	9	4
5	Cedar	10	10	10	10	8	7	7	8	—	—	12	10	9	9	8	10	10	10	5
6	Stringy Bark...	9	8	7	7	7	6	6	7	—	—	9	9	7	7	6	8	8	8	6
7	White Gum	8	8	7	7	7	6	6	7	—	—	9	8	7	6	5	7	7	7	7
8	Mountain Ash	8	8	7	7	7	6	6	7	—	—	9	8	7	6	5	7	7	7	8
9	Other Colonial Hard Woods	7	7	7	7	7	5	5	5	5	—	7	7	6	5	4	6	6	6	9
10	Kauri Pine	6	6	6	6	7	5	5	6	—	—	10	10	8	8	10[1]	8	8	8	10
11	Huon Pine	6	6	6	6	6	5	5	6	—	—	9	8	7	7	7	7	7	7	11
12	Oregon Pine[2]	—	—	—	—	6	—	—	6	—	—	9	8	8	8	8	7	7	7	12

[1] Kauri Pine for Plank-sheers will not be allowed in ships above the eight years' grade.
[2] Oregon Pine will also be admitted in ships of the grade and for the purposes above indicated.

RETURN showing the approximate injury done by the TEREDO NAVALIS and other Sea Worms to submerged Timbers, within the waters of Victoria.

No.	LOCALITY.	Date when the pile was driven.	Depth of water from the bottom surface to high water mark.	Diameter of pile when driven.	Present thickness of pile at low water line.	Description of timber.	Destruction of pile by worms.	Strength of tide where pile was driven.	Fresh, or sea water.
			Feet.	Inches	Inches				
1	Bottom of River Yarra		17			Red Gum (*a*)			Salt
2	Diamond Wharf, Melbourne	1846	5	11	11	Do. (*b*)	Nil		Fresh
3	Queen's do., do.	1842	10	12	12	Stringy Bark	Nil		„
4	Ann St. Pier, Williamstown	1858	6	15	15	Do.	Nil		Sea
5	Sandridge Old Pier	1852	3	7	5	Do.	2 inches in 8 years		„
6	Portland Old Jetty	1846	5	11	8	Do.	3 „ 14 „	1 knt	„
7	Ditto, ditto	„	10	12	10	Do.	2 „ 14 „		„
8	Ditto, ditto	„	12	7	5	Do.	2 „ 14 „		„
9	Warrnambool Old Jetty	1849	11	9		Do.	Eaten right through	3 „	„
10	Old Pier, Williamstown	1852	4	11	9	Blue Gum	2 inches in 8 years		„
11	Ditto, ditto	1855	6	11	8	Do.	3 „ 5 „		„
12	Sandridge Old Pier	1854	10	15	13	Do.	2 „ 6 „		„
13	Railway Pier ...	„	12	17	15	Do.	2 „ 6 „		„
14	Yarra Wharf, Geelong	1847	5	10	9	Do.	1 „ 13 „		„
15	Mud Flat, entrance to Yarra	1849	8	14	11	White Gum (*c*)	2 „ 11 „		„
16	Sandridge Old Pier ...	1853	3	13	11	Do.	2 „ 7 „		„
17	„ Railway Pier	1854	12	14	12	Do. (*d*)	2 „ 6 „		„
18	Steamboat Wharf, Geelong	1849	9	10	8	Do.	2 „ 11 „		„
19	Customs Do., do. ...	1852	7·6	8	6	Do.	2 „ 8 „		„
20	Old Jetty, Warrnambool	1849	11	9		Blackwood	Eaten right through	3 „	„
21	Ditto, ditto ...	„	11	9		Do.	Do. do.	„	„
22	New Steamboat Jetty, Geelong	1843	5	7	6	Sheoak (*e*)	1 inch in 17 years	½ „	„
23	Black Squall, off Williamstown ...	1854	7	Specimen 4 in. sq.		Teak (*f*)	Riddled		„
24	Railway Pier, do. ...	„	12	8		Swan River Mahogany (*g*)	Untouched		„
25	Swan River Wharf, Western Australia	1832				Do (*h*)	Do.		„

(*a*) Cut from a Red Gum tree raised from the bottom of the Yarra a few days ago, near Spencer-street Dock, where it had evidently lain many years. The worms were alive when it was brought to the surface. Considering the presence of these worms in a fresh water river somewhat unusual, I had the water at the spot where the tree was taken from pumped up at low water from different depths, and ascertained that it was fresh at and from 8 feet below the surface, at 12 feet brackish, and at 16 feet quite salt. The tree was found lying in 17 feet of water.

(*b*) Cut from a Pile drawn out of the north side of the river Yarra, about 150 feet above Cole's Dock.

(*c*) Drawn out of the north bank of the Yarra, at its junction with Hobson's Bay. It had been driven 10 feet under ground. All the timber below the surface is sound. The latter remark applies to all pieces I have seen drawn out of the ground.

(*d*) A portion of the Sandridge Railway Pier was built upon old vessels; they are all more or less eaten by the worms. The oak stern post of one is reduced from its original thickness of 18″ to 5¼″. The various piles composing the outer end of this pier, which have been down since 1858, show scarcely any symptoms of the worms This remark applies also to the Railway Pier and Breakwater at Williamstown.

(*e*) Taken from a boat jetty at Geelong. I had a piece of Sheoak pile, which formed a part of Liardet's Jetty in Hobson's Bay, driven, in 1848, in 8 feet of water. When drawn in 1854 it was but slightly touched by the worms.

(*f*) Taken out of the top side of the sunken hulk "Black Squall," which vessel has lain sunk off Williamstown since 1856. The whole hull, when seen at low water is completely riddled by the worms.

(*g*) This piece of Swan River Mahogany was cut from a fender pile at the Comet Wharf; it had been bolted to a blue gum pile just below the surface at low water.

(*h*) This is a piece of Swan River Mahogany or "jarrah" recently received from the Harbour Master, Swan River. It was cut from a pile which had formed part of a wharf there since 1832. It shews no signs of worms; yet these animals do exist there as well as here. In a work on Western Australia ("Western Australia," by Nathaniel Ogle, F.R.G.S.,) I recently read, it is stated that a jetty at Swan River, which had been built in the early days of the Colony of oak procured from a wreck, was completely destroyed by the "teredo," whereas the mahogany similarly exposed had not been touched by them. "A good specimen, which has been under water for 17 years, is sent by the Royal Engineers' Department at Freemantle to the London Exhibition, 1862. Satisfactory proofs are also furnished that it is not subject to the attacks of the white ant. In Australia vessels have been built of this wood and copper-sheathing has been dispensed with, the planking being found indestructible." *Mechanics' Journal.*

APPENDIX D.

FINE ARTS.

ONLY seventeen years before the Exhibition was opened, Otago, the Province in which it was held, was an unpeopled waste, and only twenty-five years had elapsed since the first Settlement was founded in New Zealand. Pioneer Colonists have rough, and generally stern, work before them. They may admire the beauties of Nature with which they are surrounded; may, perhaps almost unconsciously, cultivate their taste for the picturesque and the grand as they explore the country they have come to, but their hands, even if skilled, are seldom at leisure to paint its beauties. Truly does New Zealand teem with fine scenery. Snow-clad Alpine chains, softly undulating hills and extensive plains, lakes, rivers, and waterfalls; vast primeval forests of trees and huge creepers unknown in Europe, and a long coast-line scarred here and there with almost fathomless fiords walled in by lofty cliffs that rise sheer from the depths below, afford subjects worthy of any painter. It is little, then, to say that no one expected so splendid a field to be occupied in so young a Colony, but it is greatly to the credit of New Zealand that some of the pictures by her Colonists would have made reputations in Art at home. Happy in the selection of their subjects, they were also happy in their treatment of them, and great was the pleasure and surprise of lovers of art to find that the well adorned walls of the Fine Art Court owed their attractions as much to Colonial as to other artists.

Water-Colors were decidedly in the greatest favor with New Zealand artists, and the north side of the Court was hung with pictures, many of which would have graced the walls of Water-Color Exhibitions in England. Mr. John Gully's beautiful pictures of the wild Alpine scenery on the West Coast of the Middle Island were universally awarded the highest praise. His "Mount Cook from the West Coast," (180), with its finely painted glaciers, forest, and water, was generally said to be the best Water-Color in the Exhibition. His "Mount Cook Range, Wairau River" (130), "Wairau Gorge" (134), "Peak of Mount Cook" (155), "and Lake Arthur, Roto-iti" (174), were also pictures of very great merit. Mr. Gully's name will be found amongst those of the Silver Medallists.

Next to Mr. Gully's Water-Colors, almost dividing the public favor with them, were those of Mr. C. D. Barraud, Wellington. This gentleman had chosen less wild scenery for his brush, and introduced into some of his pictures people and animals illustrative of New Zealand life; amongst them, Squatters unsaddling their horses as

hey are "Waiting for the Ferry," (181), and "Out on the Run," (131), were not only admirably painted but most faithful representations of every-day life in the wild pastoral lands of the Colony, while the full length sketch of the celebrated fighting Chief, "Rangihaeta" (157), in full native costume, was a vivid portraiture of the man who killed Captain Wakefield and the Magistrate at the great Wairau massacre; and "Sunrise on the Horowhaia Lake," (133), with a group of natives, canoe, and pah, and several others of his works, were valuable alike for their beauty as pictures, and their truthful delineations of a Race fast changing its habits, and slowly but surely passing away. All Mr. Barraud's pictures show artistic feeling and careful treatment. His name will also be found amongst the Silver Medallists.

"Lake Rotoroa" (412) was a large and beautiful Oil painting of a Mountain Lake by Mr. James C. Richmond (lately Colonial Secretary), Nelson. It is a healthy sign when men who achieve distinction in public life give their leisure to Art, and no one who saw this fine, but hardly finished, picture could doubt that were Mr. Richmond to turn from the turmoil of political life and the cares of office to the more peaceful pursuit of *painting*, he would win high honors. The deep still waters of the Lake, with just a slight cat's-paw ruffling the centre, its lofty wooded banks, with the foliage of the trees, and the rugged hills in the distance, all lit up by the warm amber light of the setting sun, formed a most lovely bit of landscape which Mr. Richmond painted most charmingly. This was quite one of the best Oil paintings in the Exhibition, and well entitled Mr. Richmond to a Silver Medal. Nelson may well be proud that in Mr. Richmond's "Lake Rotoroa" and Mr. Gully's "Mount Cook from the West Coast," she sent the best Oil and the best Water-Color paintings, the work of colonial artists, in the Exhibition, nor were they second in merit to any contributed from other countries.

Mrs. Rutherford's "Old Woman Knitting" (141), Wellington, was the best of its class amongst the Water-Colors, and reminded one somewhat of Gerard Douw. The repose of the old woman's rugged features as she sat knitting, the attitude so characteristic of age, and the treatment of the whole of the details, with the single exception of an unworthily painted cat, showed considerable powers as an artist, and made us regret that in Mrs. Rutherford's other pictures she had chosen younger subjects, her forte being evidently the delineation of *old* persons. Mrs. Rutherford received a Bronze Medal.

Captain Robertson, Otago, sent several large Oil paintings, chiefly portraits of some of the most renowned clippers and other shipping of the British mercantile marine in Hobson's Bay, at Otago Heads, Port Chalmers, &c., &c. Uniting the knowledge of the practical seaman to the skill of an artist, Captain Robertson has painted some very nice pictures for which he was awarded a Bronze Medal.

Mr. S. F. Every, Otago, besides his etchings, lithographs, pen-and-ink and pencil drawings, contributed a small Oil painting (84) of H.M.S. Inconstant. It was a most excellent copy by him of the original by N. Condy, the celebrated marine painter Mr. Every had very felicitously rendered the portrait of Admiral Hayes's splendid frigate—in her day the fastest and finest vessel of her class in the British navy—and was awarded a Bronze Medal.

Mr. F. Dillon Bell, Otago; Major Coote, and Mr. E. Pharazyn, Wellington; also very deservedly received Bronze Medals for their excellent sketches of New Zealand scenery; as did Miss Greenwood, Nelson, for a sketch of the "Collingwood Quartz Ranges," that made us wish to see the pencil and the brush more often in use by the ladies of New Zealand.

Mr. C. Heaphy, Auckland, received a Bronze Medal for his Water-Color Drawings illustrative of the geology of Auckland, some of which, independent their scientific value, were very beautiful sketches.

Mr. Rumsey, Otago, was awarded a Bronze Medal for some excellent Architectural Drawings.

Mrs. James M. Balfour, Otago, sent an Electrotype from a medallion bas-relief Portrait of "Dr. Balfour," executed by her. It was evidently an excellent likeness and had been very carefully modelled. Mrs. Balfour was awarded a Bronze Medal.

Mr. W. Fox, Wellington; Mr. Justice Chapman, and Mr. Henry Chapman Otago; also contributed very nicely painted, though small, works. Several large landscapes of Otago scenery were sent by Mr. J. T. Thomson, C.E., very creditable to his industry as an amateur, and, from their faithful delineation of the natural features of the country, some of them in the earliest years of the Settlement, they are valuable as historic sketches. Mr. Thomson's least merit is as a colorist.

Numerous and some really fine pictures, mostly by British artists, contributed chiefly by Otago gentlemen, afforded much gratification to the numerous visitors to the Fine Arts Court. It was not thought desirable to give Medals either to the artists or exhibitors of these pictures; but the thanks of the Commissioners are eminently due to those gentlemen, amongst whom may specially be mentioned Mr. Prendergast, Mr. Bathgate, Mr. Justice Chapman, Mr. Mason, Mr. John Cargill, Mr. Harris, Mr. J. A. Douglas, &c., for their kindness in lending them; nor must the name of Mrs. Phillips be omitted, who sent a portrait of the late Mr. Phillips by H. B. Middleton, of Edinburgh, which was quite a gem, not only as a portrait but as a painting.

In the Corridor, &c., numerous works by Sir Robert Strange, Raphael Morghen, Sam. Cousens, Burnet, Raimbach, Gautier, Louis, &c., &c., through the kindness of Mr. H. E. Glennie, Mr. H. Orbell, Mr. J. T. Wright, Mr. H. Driver, and other gentlemen, gave great pleasure to all lovers of fine Engravings; and the Chromo-Lithographs exhibited by Mr. Turnbull and Mr. Farjeon, showed the great perfection to which that modern and very beautiful art has been already brought.

Altogether, the Fine Arts Court, whether as an evidence of the art talent which exists in the Colony, or as a means of educating as well as gratifying the taste of those who visited it, must be considered a signal success, and it was very creditable to New Zealand, not only that it contained so man good pictures, but also so few bad ones.

APPENDIX E.

STATISTICS OF NEW ZEALAND.

COMPILED FROM THE OFFICIAL RETURNS.

TABLE I.—POPULATION.

Shewing the Numbers, Sexes, and Ages of the Population of European descent in each Island, and the whole of New Zealand, compiled from the Official Returns of the Census, taken on the 1st December, 1864.

ISLANDS.	NUMBERS OF EACH AGE AND SEX.																						
	MALES.									TOTAL MALES.	FEMALES.									TOTAL FEMALES.	GENERAL TOTAL OF POPULATION.	HALF-CASTES INCLUDED IN FOREGOING TOTALS.	
	Under 5 yrs.	5 to 10.	10 to 15.	15 to 21.	21 to 40.	40 to 55.	55 to 65.	65 and upwards	Not stated.		Under 5 yrs.	5 to 10.	10 to 15.	15 to 21.	21 to 40.	40 to 55.	55 to 65.	65 and upwards	Not stated.			Males.	Females.
NORTH*	4,923	4,022	3,147	3,802	17 131	4 696	1,233	357	46	39,357	4 743	3,799	3,080	3,182	7,615	2,626	668	228	15	25,906	65,263	375	368
SOUTH	8,608	5,452	3,655	4,306	36,783	6 327	1,176	300	611	67,223	8.358	5,284	3,298	3,905	14,781	3,077	680	190	99	39,672	106,895	223	183
Total in New Zealand exclusive of H.M. Troops......	13,531	9,474	6,802	8,108	53,919	11,023	2,409	657	657	106,580	13,101	9,083	6,378	7,087	22,396	5,708	1,848	418	114	65,578	172,158	598	551
H.M. Troops and their Families; all in North Island	Officers and Men 9,186 Male Children 938									10,069	Women 1,024 Female children 880									1,904	11,978		
General Total of European Population										116,649										67,482	184,131		

* This Table includes the Military Settlers and the Colonial Defence Force, and their Families.

APPENDIX E.—*TABLE II.—POPULATION.*

Shewing the Numbers and Sexes of the Settlers, the Military Settlers, the Colonial Defence Force, and H.M. Troops, and their Families, in each Island and the whole of New Zealand; from the Official Returns of the Census taken December 1st, 1864.

	North Island.			South Island.			New Zealand.		
	Males.	Females.	Total Population.	Males.	Females.	Total Population.	Males.	Females.	Total Population.
Settlers and their Families	34,218	24,663	58,881	67,223	39,672	106,895	101,441	64,335	165,776
"Military Settlers" and "Colonial Defence Force" and their Families	5,139	1,243	6,382	...	...	...	5,139	1,243	6,382
"H.M. Troops" and their Families	10,069	1,904	11,973	...	...	...	10,069	1,904	11,973
Totals	49,426	27,810	77,236	67,223	39,672	106,895	116,649	67,482	184,131

APPENDIX E.—*TABLE III.—EDUCATION.*

Shewing the Numbers of the Population (of European descent) in each Island and the whole of New Zealand, able or not able to read or write; from the Official Returns of the Census taken on the 1st December, 1864.

Islands.	Degree of Education.																	Not described.	Total Population.
	Under 15 Years.						15 Years and upwards.						Members of Universities included in foregoing numbers.		Totals of both Sexes and all Ages.				
	Cannot Read.		Read only.		Read and Write.		Cannot Read.		Read only.		Read and Write.								
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	British.	Foreign.	Cannot Read.	Read only.	Read and Write.		
North ...	6,260	5,899	1,536	1,489	4,283	4,213	1,143	698	835	956	25,272	12,629	155	19	14,000	4,816	46,397	50	65,263
South ...	9,089	8,833	2,340	2,344	5,354	4,839	1,434	717	1,209	1,426	46,148	20,350	184	19	20,073	7,319	76,691	2,812	106,895
Total in N.Z.	15,349	14,732	3,876	3,833	9,637	9,052	2,577	1,415	2,044	2,382	71,420	32,979	339	38	34,073	12,135	123,088	2,862	172,158

TABLE IV.—SCHOOLS.

Shewing the total numbers attending Schools in each Island, and the whole of New Zealand, compiled from the Official Returns of the Census taken 1st December, 1864.

Islands.	At Day Schools.			At Sunday Schools.			Total at Any School.
	Supported by Government Aid.	Private, or not receiving Government Aid.	Total at Day.	At Sunday only.	At both Sunday and Day.	Total at Sunday.	
North	2,452	4,410	6,862	1,073	3,849	4,922	7,935
South	5,451	3,662	9,113	1,568	5,109	6,677	10,681
Total in New Zealand ..	7,903	8 072	15,975	2,641	8,958	11,599	18,616

TABLE V.—LAND IN CULTIVATION, &c.

Shewing the quantity of Land in the possession of Europeans in each Island, and the whole of New Zealand, under Crop and Fenced, on the 1st December, 1864.

Crops, &c.	North Island.			South Island.			Total in New Zealand.		
	A.	R.	P.	A.	R.	P.	A.	R.	P.
Wheat	1,906	3	0	23,700	2	20	25,607	1	20
Oats	6,005	2	0	44,993	0	20	50,998	2	20
Barley	337	2	0	4,567	0	10	4,904	2	10
Maize	793	3	0	190	1	0	988	0	0
Potatoes	4,657	0	10	6,507	2	12	11,164	2	22
Garden or Orchard	3,521	0	28	5,084	0	24	8,605	1	12
Sown Grasses ...	194,995	1	31	77,128	1	32	272,123	3	23
Other Crops ...	2,399	1	10	5,863	2	27	8,262	3	27
Total under Crop...	214,620	1	29	168,034	3	25	382,655	1	14
Total Fenced ...	330,303	0	23	742,080	1	32	1,072,383	2	15

APPENDIX E.—TABLE VI.—HOUSES.

Shewing the Numbers and Description of HOUSES in each Island and the whole of New Zealand, on the 1st December 1864.

ISLANDS.	HOUSES.				
	Wood.	Stone or Brick.	Raupo.	Other Materials.	TOTALS.
NORTH	10,376	396	532	952	12,256
SOUTH	15,087	686	27	9,940	25,740
TOTALS IN NEW ZEALAND ...	25,463	1,082	559	10,892	37,996

TABLE VII.—GOLD EXPORTED.

Shewing the Quantity and Value of Gold, the produce of Goldfields in each Island and the whole of New Zealand, exported from the Colony from the 1st *April* 1857, *to* 31*st December*, 1864.*

PRODUCE OF	DURING 1864.		FROM 1ST APRIL, 1857, TO 31ST DEC., 1863.		TOTAL EXPORTED FROM NEW ZEALAND TO 31ST DEC., 1864.	
	OZ.	£	OZ.	£	OZ.	£
NORTH ISLAND... ...	3,448	10,552	6,076	19,323	9,524	29,875
SOUTH ISLAND	476,723	1,847,295	1,263,112	4,894,560	1,739,835	6,741,855
TOTAL FROM NEW ZEALAND	480,171	1,857,847	1,269,188	4,913,883	1,749,359	6,771,730

* The Returns state:—"The value has been calculated at the uniform (estimated) rate of L.3 17s. 6d. per oz, 'with the exception of' the gold from the North Island, 'for which the ascertained value has been given.' This Table is compiled from the *Monthly Returns of Gold exported*, which do not in all cases exactly correspond with the Quarterly Trade Returns of Exports from the Colony as furnished by the Collectors for their respective Ports, from which the General Table of Exports (No. VIII.) has been compiled."

TABLE VIII.—EXPORTS.*

Showing the Value of the Exports from each Island and from the whole of New Zealand for the year* 1864. *From Official Returns.

ARTICLES.	NORTH ISLAND.	SOUTH ISLAND.	TOTALS FOR NEW ZEALAND.
	£	£	£
Bark	315	...	315
Bacon	...	90	90
Butter and Cheese	108	1,111	1,219
Chrome Ore	4,910	...	4,910
Cordage and Wool Lashing	8	...	8
Curiosities	73	232	305
Firewood...	5	...	5
Flax	97	65	162
Flour	25	...	25
Fruits	4	49	53
Gold Dust	10,825	1,845,005	1,855,830
Grain (oats, wheat, &c.)	...	722	722
Gum (Kauri)	60,590	...	60,590
Hides	5,595	6,377	11,972
Horns, Hoofs, Bones	115	198	313
Iron Sand	52	...	52
Oil (fish)	1,615	1,330	2,945
Potatoes, Onions, &c.	602	483	1,085
Plants, &c.	326	262	588
Plumbago	...	320	320
Skins	1,963	3,333	5,296
Stock (live)	230	111	341
Tallow	821	1,044	1,865
Timber	23,558	1,208	24,766
Whalebone	120	255	375
Wool	285,555	785,442	1,070,997
Not classified	4,583	902	5,485
Totals, Produce and Manufactures of Colony	402,095	2,648,539	3,050,634
Other Colonial, British, and Foreign Produce	45,976	87,796	133,772
Specie	195,000	28,500	223,500
†Totals	643,071	2,764,835	3,407,906

* This Table has been compiled from the *Quarterly Returns* of Exports published in the New Zealand Gazettes, the *Annual* returns for 1864 not having yet been published.—Dunedin, January 12th, 1866.—ED.

† Whilst printing this sheet the Registrar-General has kindly forwarded to me the Tables showing Total Values of Exports from the Colony for 1864, but not the Tables showing the details. I find there is a marked discrepancy between the figures of the *Quarterly Returns* from which the above Export Table has been compiled and the *Annual Table* received to-day, and I therefore give both, being unable to account for the difference between the Quarterly and the Annual Returns.

Total Exports from New Zealand for 1864, as given in the Quarterly and the Annual Returns:—

	Quarterly.	Annual.	Difference,
North Island	643,071	638,171	4,700
South Island	2,764,835	2,763,496	1,339
Total for New Zealand	£3,407,906	£3,401,667	£6,239

Dunedin, 9th January, 1866.—ED.

TABLE IX.—IMPORTS.

Shewing the value of the Imports into each Island and the whole of New Zealand for the year 1864. *From Official Returns.*

ARTICLES.	NORTH ISLAND.	SOUTH ISLAND.	TOTALS.
Agricultural Implements, &c. ...	£4,472	£17,079	£21,551
Ale, Beer, Cider, Perry, &c. ...	71,762	149,298	221,060
Apothecary Wares	6,056	44,848	50,904
Arms and Ammunition, &c.	7,387	11,671	19,058
Bags, Sacks, &c.	12,502	23,990	36,492
Books, Printed	10,365	15,971	26,336
Boots and Shoes	54,403	109,624	164,027
Brushware and Perfumery	6,367	8,739	15,106
Candles	37,402	33,968	71,370
Carts and Drays	18,520	21,419	39,939
Cheese	15,896	26,446	42,342
Clocks and Watches	31,312	28,621	59,933
Coals	61,554	104,701	166,255
Coffee, Chicory, and Chocolate ...	15,412	17,941	33,353
Copper Manufactures	1,532	990	2,522
Cordage and Wool-lashing	7,887	9,972	17,859
Drapery Goods	464,829	714,986	1,179,805
Earthenware and Chinaware	11,239	25,982	37,221
Fruits	28,217	50,994	79,211
Furniture	12,360	68,925	81,285
Glassware	10,809	36,585	47,394
Grain	187,921	81,781	269,702
Hardware and Cutlery	29,274	101,116	130,390
Harness and Saddlery	29,433	26,744	56,177
Hops	9,958	8,729	18,687
Instruments, Musical and Scientific...	8,870	20,304	29,174
Iron	35,999	204,634	240,633
Ironmongery	59,502	75,647	135,149
Lead	1,917	5,905	7,822
Leather	9,929	14,594	24,523
Machinery	35,261	64,670	99,931
Oil	19,385	38,972	58,357
Oilman's Stores	57,045	70,881	127,926
Paint and Painter's Materials	7,869	17,165	25,034
Provisions	263,630	436,501	700,131
Rice	10,905	5,942	16,847
Ship Chandlery	17,764	22,148	39,912
Salt	3,500	5,440	8,940
Seeds	9,671	16,971	26,642
Soap	8,851	15,260	24,111
Spirits	94,375	158,313	252,688
Stationery	31,700	62,525	94,225
Stock (Live Stock)	209,183	324,891	534,074
Sugar	83,940	146,414	230,354
Tea	49,662	81,893	131,555
Tin	2,782	8,050	10,832
Tobacco	88,377	125,293	213,670
Vinegar	1,692	3,217	4,909
Wine	47,248	93,703	140,951
Articles not specifically described ...	194,209	382,890	577,099
Totals	£2,509,744	£4,133,724	£6,643,468
Specie	336,187	21,000	357,187
GENERAL TOTALS	£2,845,931	£4,154,724	£7,000,655

METEOROLOGY.

COMPARATIVE TABLE of CLIMATE at the undermentioned places in New Zealand in the Year 1864.

LOCALITY.	Mean maximum temperature.	Mean minimum temperature.	Mean temperature for the year.	Maximum temperature on any day in the shade.	Minimum temperature on any day.	Thermal range.	Mean temperature of Wet Bulb.	Mean temperature of Dew Point.	Mean height of Barometer.	Maximum height of Barometer on any day.	Minimum height of Barometer on any day.	Barometric Range.	Mean Elastic Force of Vapour.	Mean Humidity. 100=Saturation.	Total Rain Fall in Inches.	Maximum Rain Fall in any 24 hours.	Number of days on which Rain fell.	Mean Force of wind in lbs. on square foot.	Maximum Force of Wind on any day.
Mongonui	67·7	49·2	a58·4	87·5, Jan. 26	28·6, Aug. 3	58·9	a54·6	51·3	29·933	30·486, July 4	29·109, Aug. 11	1·379	382	77	67·9	2·65, July 7	148	·58	12·7, N.E., July 8
Auckland	68·9	51·7	b63·3	91·0	35·8	55·2	a45·4	52·2	29·824	30·454, July*	29·130, Aug.*	1·324	398	67	37·4	2·06, Dec. 19	160	c1·00	
Taranaki	67·9	47·5	a57·7	86·0, Dec. 28 to 30	32·0, { July 12, Aug. 3 }	54·0	a55·2	51·6	29·903	30·594, April 18	29·128, Aug. 26	1·466	389	76	43·8	2·32, Sept. 12	138	d ·79	20·0, S., June 18
Napier	62·2	47·5	54·9	e	e	e	52·8	48·3	29·846	e	e	e	342	71	49·3	e	69	1·72	e
Wellington	61·0	49·0	a55·0	75·0, { Jan. 28, Feb. 11, 21, 23, Dec. 31 }	32·0, June 21	43·0	b51·7	47·3	29·884	30·404, June 3	28·933, Nov. 13	1·471	329	73	44·5	1·95, April 8	139	1·38	22·7, S.S.W., June 17
Nelson	68·9	44·8	a54·3	84·0, Jan. 23	27·0, Aug. 29	57·0	b57·9	56·2	29·973	30·535, June 3	29·065, May 16	1·470	467	85	68·4	6·08, Nov. 6	85	1·18	8·1, N.E., July 7
Christchurch	62·5	44·1	a53·3	88·7, Feb. 11	26·2, Aug. 2	62·5	a49·2	45·0	29·855	30·578, June 3	29·084, May 18	1·544	305	74	22·0	1·03, Oct. 21	115	·74	17·7, N.W., Feb. 1
Dunedin	59·1	42·9	51·0	88·0, Feb. 10	29·8, July 31	58·2		f42·9	29·937	30·609, June 3	28·806, Feb. 4	1·803	279	69	24·2	1·25, Jan. 9	186	·27	12·3, W.N.W., Feb. 1
Southland g			50·9	88·2	17·0	66·2	46·9	42·6		30·420	28·591	1·829		74	51·07		149		

Earthquakes occurred at Taranaki on the 5th January, 22nd February, 5th March two, and on the 12th March, all slight; and at Wellington on the 5th, 6th, 11th, 29th, and 30th January, 14th March, 5th April, and on the 5th and 20th September, all slight shocks. The rainfall recorded in 1864 was considerably less than in 1863. The difference between the two years was, in Auckland 6.8 inches, in Taranaki 19.9 inches, in Wellington 26.1 inches, in Nelson 3.9 inches, and in Dunedin 8.8 inches. Dr. Mouatt, P.M.O., who kindly furnished the data for the Auckland Return, remarks,—"The average annual fall of rain at Auckland during the last eleven years was 46,9 inches," showing that the fall during 1864 was 9·5 inches below the average as determined by that period. The rainfall at Greenwich during 1864, 16.7 inches, was the smallest on record, and was 8.6 inches below the annual average.

NOTES.—*a*, from self-registering instruments; *b*, from observations morning and afternoon; *c*, mean of 10 months; *d*, mean of 11 months; *e*, an abstract only for the year was sent from Napier—the figures for these columns not given; *f*, from three observations; *g*, abstract for Southland, has been kindly furnished by C. R. Marten, Esq., Corresponding Member of the British Meteorological Society, from notes taken at his observatory at Martendale.

* *No dates given.*—ED.

NEW ZEALAND EXHIBITION, 1865.

MEDALS.

THE following is a List* of the Persons to whom MEDALS have been awarded under the Resolution of the Commissioners passed on the 5th October, 1864 :—"That MEDALS or some other AWARD OF MERIT, be granted by the Commissioners to persons who have advanced the Arts, Industries, and Manufactures of New Zealand, by zealous services, or by sending Articles to the Exhibition which do not fall under the awards of the Juries, but which are of great merit."

GOLD MEDAL.

ECCLES, ALFRED, Otago	As Author of the Plan of the Exhibition, and the Chief Instrument of its Success.

SILVER MEDALS.

BALFOUR, J. M., C.E., Otago ...	For his zealous and valuable services as Reporter in several very important Classes, of the Juries of which he was the Chairman; his elaborate and extremely interesting Experiments on the Strength of Timbers, &c., and Report thereon; and his services generally as Chairman of the Associate Committee of Consulting Engineers.
BARRAUD, C. D., Wellington	For his beautiful Water Color Drawings of New Zealand Scenery, &c.

* The list is alphabetical under each class of Medals.—ED.

BEALEY, S., Superintendent, Canterbury	Vice-President.
BEVERLEY, ARTHUR, Otago	For his two eminently ingenious and useful Inventions—the Platometer, and Atmospheric Clock—made and exhibited by him; and his zealous services on behalf of the Exhibition.
BLACKETT, JOHN, C.E., Nelson ...	For the bold design and successful erection of several novel and ingenious Bridges in New Zealand.
BRANIGAN, ST. JOHN, Otago	For his zealous services on behalf of the Exhibition; especially the excellent arrangements made by him as Chief Commissioner of Police of Otago, to which the Commissioners mainly attribute the great success attending the care of the Exhibits.
BROWN, CHARLES, Superintendent, Taranaki	Vice-President.
BULLER, W. S., F.L.S., Wellington ...	For his interesting Essay on the Ornithology of New Zealand, and the Collection of admirably preserved specimens of New Zealand Birds exhibited by him.
CANTRELL, R. S., Otago	For his very zealous and valuable services as a Commissioner.
CARGILL, E. B., Otago	Commissioner.
CARGILL, JOHN, Otago	Commissioner.
CARTER, T., Superintendent, Marlborough	Vice-President.
CLAPCOTT, H., Otago	For his zealous and valuable services as a Commissioner.
COLENSO, W., Hawke's Bay	For his interesting Essays on the Botany of the North Island, and the History of the Maories; and his numerous Exhibits.
COUNCIL ON EDUCATION, THE LORDS OF THE, COMMITTEE OF, KEW ...	For the excellent and instructive Drawings, executed by the Pupils in the various Schools of Art under Government, exhibited by them.
CRAWFORD, J. C., Wellington	For his interesting Essay on the Geology of the North Island; and Exhibits illustrating the Geology of the Province of Wellington.
CROWTHER, Dr., W. L., Tasmania ...	For his very zealous services as Chairman of the Tasmanian N. Z. Exhibition Committee; his numerous and valuable Exhibits; and in recognition of his efforts to develope Colonial Industrial Resources.

DICK, THOMAS, Otago	For his zealous and valuable services as a Commissioner, and as the Honorary Treasurer of the Exhibition.
DOBSON, E., C.E., Canterbury	For his interesting and instructive contributions to the Exhibition in connection with the Lyttelton and Christchurch Railway, and his able prosecution of the Works of that Railway.
DRIVER, HENRY, OTAGO...	For the valuable services rendered to the Exhibition by his Firm's excellent and liberal management of the Inter-Colonial Live Stock Show held in connection with it, and handsome provision of Medals for the successful Exhibitors thereat.
FEATHERSTONE, I. E., Superintendent, Wellington	Vice-President.
FITZHERBERT, WILLIAM, Wellington ...	Vice-President.
FORRESTER, THOMAS, Otago	For his zealous and useful services in performance of the duties of Superintendent of the Exhibition, in succession to Mr. Horsman.
FOX, WILLIAM, Wellington	Vice-President.
GILLIES, T. B., Otago	For his zealous and valuable services as a Commissioner.
GOULD, J. London	For the valuable services rendered to the Natural History of New Zealand by his Ornithological labors.
GRAHAME, ROBERT, Superintendent, Auckland	Vice-President
GRAY, J. E., Ph.D., F.R.S., London ...	For the valuable services rendered to the Natural History of New Zealand by his Ornithological labors.
GULLY, JOHN, Nelson	For his beautiful Water Color Drawings of the Alpine and other Scenery of New Zealand.
HAAST, JULIUS VON, Ph.D., F.G.S., F.L.S., &c.. &c., Canterbury	For his interesting and instructive Essay on the Physical Geography and Geology of the Provinces of Canterbury, Nelson, and Marlborough; his extensive and admirably arranged Collections, illustrating the Physical History of the same Provinces; his general services to New Zealand as a Naturalist and Explorer; and his zealous efforts to promote the success of the Exhibition.

HACKET, T. R., OTAGO	For his merit as the first person to draw attention to the commercial value of the discovery of Chrome Ore in New Zealand; his interesting Essay on the Mining and Mineral Products of New Zealand; and his zealous services generally on behalf of the Exhibition.
HARRIS, J. H., Superintendent, Otago...	PRESIDENT.
HECTOR, JAMES, M.D., F.R.S.E., F.G.S., &c., &c., Otago	For the indefatigable and unwearied services rendered by him to the Exhibition as a Promoter, Commissioner, and Juror; for his valuable assistance in Editing the Essays; and for his interesting and instructive Essay on the Geology of Otago, Southland, &c.; the valuable Supplementary Chemical Report, by himself and Mr. Skey, on Class I.; and the splendid Collections illustrating the Physical History of Otago, made and exhibited by him; and his general services to New Zealand as a Naturalist and Explorer.
HEWITT, GEORGE, Bradford	For his zealous services on behalf of the Exhibition.
HOCHSTETTER, DR. F. VON, Vienna ...	For the able and valuable services rendered to the Colony by his published works on the Natural History of New Zealand.
HOLMES, R. L., Canterbury	For his zealous services as Secretary and Agent for the Canterbury Local Committee.
HOOKER, J. D., M.D., F.R.S., &c., &c., Kew	For the able and zealous services he has rendered to the Colony by his works on the Botany of New Zealand.
HORSMAN, E., Otago	For his zealous and able performance of the duties of Superintendent of the Exhibition up to the time of his resignation.
INDIA.—H.M. PRINCIPAL SECRETARY OF STATE FOR; The Right Honorable SIR CHARLES WOOD, Bart., &c., &c., &c....	For the numerous admirably arranged contributions to the Exhibition from the Indian Museum, London, illustrative of the Products and Manufactures of British India and its Dependencies; very many of which were presented by the Secretary of State to the Commissioners for a Local Museum.

King, The late Edward, Auckland ...	For his zealous services as Honorary Secretary to the Auckland Local Committee.
Lindsay, Dr. Lauder, FR.S.E., Perth, N.B.	For his numerous and instructive Exhibits; and his interesting Researches on the Brown Coals of Otago, and the Properties of the Tutu plant.
Ludlam, A., Wellington	For his very practical and interesting Essay on the "Cultivation and Acclimatization of Trees and Plants in New Zealand;" and in recognition, of the valuable and exact information contributed by him in connection with his numerous Exhibits of fine and cross-bred Wools; and, of his successful efforts to produce new and improved breeds of Long Wooled Sheep specially adapted to New Zealand.
Maclean, John, Otago	For the valuable services rendered to the Exhibition by his Firm's excellent and liberal management of the Inter-Colonial Live Stock Show, held in connection with it, and handsome provision of Medals for the successful Exhibitors thereat.
Mantell, W. B. D., Wellington ...	Vice-President; and for his valuable services to New Zealand in connection with its Geology.
Martin, R. B., Otago	For his very zealous and valuable services as a Commissioner.
Mason, W., Otago	For his very zealous and valuable services as a Commissioner.
Mason & Clayton, Otago	For the Design of the Building in which the Exhibition was held, its architectural beauty, and the skilful erection of so massive a structure on a foundation requiring very extraordinary precautions.
M'Lean, Donald, Superintendent, Hawke's Bay	Vice-President.
Menzies, Dr., late Superintendent, Southland	Vice-President.
Morrison, John, London	For his valuable services as Agent for the Exhibition in Europe and America; and in recognition of his zeal in the service of New Zealand generally.

MORSE, H. P., Otago	For the able and unwearying performance of his duties as Secretary to the Commissioners, to which much of the success of the Exhibition is due; and for his valuable assistance in the work of Editing the Jurors' Reports and Essays.
MUNRO, DR., Nelson	For his interesting Essay on the Botany of New Zealand.
OWEN, RICHARD, D.C.L., F.R.S., &c. &c., London	For the valuable services rendered to the Natural History of New Zealand by his Works on Comparative Anatomy, especially on the Anatomy of the Moa.
PATERSON, JAMES, Otago	Commissioner.
RATTRAY, JAMES, Otago...	For his zealous and valuable services as a Commissioner.
REYNOLDS, W. H., Otago	For his services as a Commissioner.
RICH, F. D., Otago	In recognition of his valuable services to the Colony as a Breeder of pure Merino Sheep; and the splendid Fleeces exhibited by him.
RICHARDSON, MAJOR, Otago	For his services as a Vice-President.
RICHMOND, MR. JUSTICE, Otago ...	For his zealous services as a Vice-President.
RICHMOND, J. C., Nelson	For his beautiful Oil Painting of Lake Rotoroa; and his services as Honorary Secretary of the Nelson Local Committee.
ROBINSON, The late J. P., Superintendent, Nelson, ...	Vice-President.
SHORTLAND, DR., Auckland	For his interesting Essay on the Maoris.
SHURY, A. H., Otago	For his zealous services in connection with the Gold Exhibits, and the valuable information he afforded.
SIMMONDS, P. L., London	In recognition of special services to the New Zealand Exhibition as a Sub-Agent for Europe; his interesting Exhibits; and his services generally towards the development of Colonial Industrial Resources.
SMITH, PROFESSOR, Sydney University	For his valuable services in connection with the Experiments on the strength of Colonial Woods.
TAYLOR, J. P., Superintendent, Southland	Vice-President.
TAYLOR, REV. R., Wellington	His interesting Essay on the Natural History of New Zealand.
THOMSON, J. T., C.E., Otago	As a Member of the Associate Committee of Consulting Engineers; and for his zealous services generally on behalf of the Exhibition.

WATSON, DR. JOHN FORBES, London ...	For the excellent and instructive Catalogue of the Indian Exhibits, prepared by him.
WEBB, J. S., Otago	For his very zealous services as the Honorary Secretary of the Otago Local Committee; and as a Juror in important Classes.
WEBBLEY, JOSEPH, Nelson	For his successful introduction of the Manufacture of "Tweeds" from New Zealand Wools, into the Colony.
WELD, A., Canterbury	Vice-President.
WILKINSON, JOHN, Hawke's Bay ...	For his zealous services as Chairman of the Hawke's Bay Local Committee.
WOOD, READER G., Auckland	Vice-President.
VOGEL, JULIUS, Otago	For his zealous services as a Commissioner.

BRONZE MEDALS.

ARROWSMITH, J., London	For services rendered to the Geography of New Zealand.
BAKER, J. H., Southland	For his services to the Exhibition.
BALFOUR, J. M., MRS., Otago	For her Basso-relievo in Copper.
BARNES, W. H., Canterbury	As Manufacturer of his Registered Stove.
BATHGATE, JOHN, Otago	For zealous services to the Exhibition.
BEGG, CHARLES, Otago	For Piano Manufactured by him in New Zealand, and of New Zealand woods.
BEISSEL, G., Otago	For his Manufacture of Glue in New Zealand, from waste materials.
BELL, F. DILLON, Otago...	For his Water-color Drawings.
BOARD OF TRADE, Quebec, Canada ...	For interest taken in the New Zealand Exhibition.
BRADFORD WOOL ASSOCIATION, Bradford	For zeal in promoting the development of Colonial Industrial Resources.
BRAITHWAITE, A. S., C.E., Nelson ...	For his zealous services as Agent for Nelson.
BROWN, E. T., Otago	For his ingenious Model of the Township of Alexandra, Otago.
BUTTERWORTH, J., Otago	For zealous services to the Exhibition.
CHAPMAN, MR. JUSTICE, Otago... ...	For zealous services to the Exhibition.
CLIFFORD, G. P., Otago...	For services rendered to the New Zealand Exhibition.
COOTE, MAJOR, Wellington	For his Water Color Drawings of New Zealand Scenery.
COTTON SUPPLY ASSOCIATION, Manchester	For zeal in promoting the development of Colonial Industrial Resources.
CRAVEN, JOSEPH, Bradford	For his excellent Manufactures of New Zealand Wool.
CRESSWELL, C. F., Hobart Town ...	For the extensive and useful Collection of Seeds exhibited by him.

CURRIE, D. S., Dunedin...	For his zealous services as Clerk in the Secretary's Office.
DARWENT, JOSEPH, Adelaide	For his zealous services as Correspondent in South Australia.
DAVIES, W., Wellington	For his zealous efforts to utilise New Zealand Flax.
DOUGLAS, J. A., Otago	For his zealous services to the Exhibition.
DOYNE, E., C.E., Canterbury	For his ingenious Apparatus for allowing the Expansion of Girders over the Piers of long Iron Bridges.
EBSWORTH, E. & O., Sydney	For their excellent Manufactures from New Zealand and other Wools.
EVERY, S. F., Otago	For his Oil Painting of H.M.S. *Inconstant*.
EWEN, J. A., Otago	For his zealous services to the Exhibition.
FISHER, ALDER, Auckland	For his services as Clerk in the Exhibition Building.
FOSTER, JOHN & SON, Bradford ...	For their excellent Manufactures from New Zealand Wool.
GLOVER, H. H., Canterbury	For his Design for the "Honorary Certificates" of the Exhibition.
GORE, R. B., Otago	For his zealous services in connection with the Meteorology of New Zealand.
GREENWOOD, MISS, Canterbury ...	For her Water Color Sketches of New Zealand Scenery.
HEAPHY, CHARLES, Auckland	For his Drawings illustrative of the Geology of Auckland.
HILL, JOHN, Otago	For his zealous efforts to extend the use of New Zealand Woods in Cabinet-work.
HILL, WALTER, Brisbane	For his zealous services to the Exhibition.
HUNTER GEORGE, Wellington	For his valuable services in promoting the growth of Long Wool in New Zealand.
JAMES, WILLIAM, Wellington	For great success in the employment of New Zealand Woods in Inlaid Furniture.
JOHNSTON, W. and A. K., Edinburgh ...	For services rendered to the Geography of New Zealand.
KENTLY, JOSEPH, Canterbury	For his successful Manufacture of Ploughs in New Zealand.
LANCE, J. D. and H., Canterbury ...	For zealous endeavours to promote the Improvement of New Zealand Wools.
LANSEIGNE, J., Otago	For his zealous services to the Exhibition.
LEES, W. H., Otago	For his services on the Associate Committee on Wools.
LILLYWHITE, JOHN, London	As the only Exhibitor of Articles intended to assist in Physical Education; and their great excellence.
MARSHALL, SONS, and Co., Gainsboro'...	For their very excellent Portable Steam Engine for Farm purposes.
MATTHEWS, GEORGE, Otago	For his zealous services to the Exhibition

M'Coy, Professor, Melbourne ...	For his zealous services on behalf of the Exhibition.
Morton, Francis, and Co., Liverpool...	For their extensive exhibits of Galvanized Iron Fencing, particularly adapted for Colonial use.
North and Scoular, Otago	For elegance of design and finish in the Furniture manufactured by them of wood from the Fiji Islands.
Paterson, T., C.E., Otago	For Models showing the construction of the excellent Bridges built in Otago by him.
Petermann, Dr. A., London	For services rendered to the Geography of New Zealand.
Petre, Hon. W., Wellington	For his services in forwarding Woods for Testing purposes.
Pharazyn, E., Wellington	For his Water Color Drawings.
Phillips and Hill, Birmingham ...	For their extensive Exhibits of Galvanized Iron Fencing, particularly adapted for Colonial use.
Pollen, Dr., Auckland	For his zealous efforts to introduce the Manufacture of Pottery in New Zealand.
Patent Plumbago Crucible Company, London	For their excellent Blacklead, and other Crucibles, &c., suitable for gold melting.
Rauft, Theodore, Otago	For his ingenious Models of a River-bank Claim on the Molyneux, and of "Lignite Workings."
Read, Gabriel, Otago	As the first person to give practical value to the Discovery of Gold in Otago.
Redmayne, Thomas, Otago	For zealous services to the Exhibition.
Rees, A. C., Otago	For his interesting Exhibits.
Roberts, J., Otago	For his Invention of a very simple and useful Windlass.
Robertson, Captain, Otago	For his Marine Paintings in Oil.
Rochfort, John, Nelson	For his services to New Zealand as an Explorer.
Rumsey, G., Auckland	For his Architectural Sepia Drawings.
Rutherford, Mrs., Wellington ...	For her Water Color Drawings.
Scott, George, Otago	For his ingenious and effective use of New Zealand Materials in the manufacture of a Garden Chair.
Seuffert, Antone, Auckland	For great success in the employment of New Zealand Woods in Inlaid Furniture.
Simmons, Rev. F. C., Otago	For his valuable services to the Exhibition.

Skey, W., Otago	For his valuable services as Chemical Analyst to the Exhibition, and his valuable Supplementary Chemical Report, in conjunction with Dr. Hector, on Class I. Appendix A.
Skinner, T. C., Otago	For his zealous services to the Exhibition.
Stanford, E., London	For services rendered to the Geography of New Zealand.
Steadman, J. A., Dunedin	For the zeal shown by him on behalf of the Exhibition.
Strode, A. C., Dunedin	Trustee.
Tatton, T. W., Nelson	For general zeal on behalf of the Exhibition, and his numerous interesting Exhibits.
Trail, Charles, Otago	For zealous services in connection with the Conchology of New Zealand.
Turnbull, George, Dunedin	For zealous services on behalf of the Exhibition.
Union Steam Saw, Moulding, Sash, and Door Company, Auckland	For the successful Introduction of Steam Machinery for the Manufacture of Doors, &c., into New Zealand.
Vine, C. B. Otago	For his services in connection with the Exhibition, as Clerk of the Building.
Ward and Reeves, Canterbury	For the successful Introduction of Chromo-lithography into New Zealand.
Webber, Charles, Hawke's Bay	For his services in forwarding Woods for Testing purposes.
West, G. R., Otago	For services to the Exhibition.
Weston, —, Birmingham	For his excellent Differential Pulley Blocks.
Wheatstone, Professor, London	For the useful Private Telegraph invented by him, and exhibited by Mr. James Woodford, Canterbury.
Whiting, George, Hobart Town	For zealous services to the Exhibition.
Wilson, Misses, Hawke's Bay	For their praiseworthy efforts to produce Dried Fruits in New Zealand.
Woodward, John, Wellington	For his zealous services to the Exhibition.
Young, W. Carr, London	For his services to the Exhibition.
Young, William, Otago	For his zealous services to the Exhibition

ALFRED ECCLES,

Honorary Secretary.

ERRATA.

Page 70 (Note) *for* " 4" *read* "1864."
„ 85 line 7, *for* "Lanseigne" read "Lanseigne."
„ 98 „ 2, *for* "Damier" *read* "Daurier."
„ 199 „ 7, *for* "Hawke's Bay" *read* "Wellington."
„ 203, insert signature "J. M. Balfour, Chairman and Reporter."
„ 306 line 6, *for* "Cotswold" *read* "Leicester."
„ 402 „ 28, *for* "an impaired" *read* "unimpaired."
„ „ 35, *for* "Taraiu" *read* "Taraire."
„ 466 „ 28, *for* "space" *read* "span."
„ 469 „ 2 from foot, *for* "native woods" *read* "mature wood."
„ „ „ *for* "their" *read* "its."
Tables—Page 89, Dunstan Assay B.N.Z., *for* "23 2 0" *read* "23 0 2."
„ „ „ B.N.S.W., *for* "23 1 0" *read* "23 0 0."
„ „ „ Average, *for* "23 0 7" *read* "23 0 0."
„ „ Lammerlaw Assay U.B.A., *for* "23 1 1" *read* "22 1 1."
„ „ „ „ Average, *for* "23 1 0" *read* "22 1 0."

INDEX.

ERRATA.

Page 70 (Note) *for* " 4" *read* "1864."
„ 85 line 7, *for* "Lauseigne" read "Lanseigne."
„ 98 „ 2, *for* "Damier" *read* "Daurier."
„ 199 „ 7, *for* "Hawke's Bay" *read* "Wellington."
„ 203, insert signature "J. M. Balfour, Chairman and Reporter."
„ 306 line 6, *for* "Cotswold" *read* "Leicester."
„ 402 „ 28, *for* "an impaired" *read* "unimpaired."
„ „ 35, *for* "Taraiu" *read* "Taraire."
„ 466 „ 28, *for* "space" *read* "span."
„ 469 „ 2 from foot, *for* "native woods" *read* "mature wood."
„ „ „ *for* "their" *read* "its."
Tables—Page 89, Dunstan Assay B.N.Z., *for* "23 2 0" *read* "23 0 2.'
„ „ „ B.N.S.W., *for* "23 1 0" *read* "23 0 0."
„ „ „ Average, *for* "23 0 7" *read* "23 0 0.'
„ „ Lammerlaw Assay U.B.A., *for* "23 1 1" *read* "22 1 1.'
Average, *for* "23 1 0" *read* "23 1 0'

ADDITIONAL ERRATA.

Tables—Page 475, 9 Kohwai—Remarks—*for* "bark" *read* "break."
„ 480, Kauri, (2nd) GM, *for* "W S δ" 130.88 1.54" *read* "— 130.88 1.54·
„ 481, 29 Rimu, *for* "cupressimum" *read* "cupressinum."
„ 484, Whau—Remarks—*for* "least" *read* "last."
„ 490, *For* "Curled Blue Gum" *read* "Blue Gum."
„ 493, 48 Rimu, S.G., *for* ".563" *read* ".593."
„ 494, 49 *for* "BEACH" *read* "BEECH·"
„ 504, Chrome Ore, *transfer* £4,910 *from* North *to* South Island.
„ „ Totals, *for* "402,095 and 2,648,539" *read* "397,185 and 2,653,449."
„ „ †Totals, *for* "643,071 and 2,764,835" *read* "638,161 and 2,769,745."

	Quarterly.	Difference,		Quarterly.	Difference,
„ „ Note†, *for*	"643,071	4,700"	*read*	"638,161	10."
	"2,764,835	1,339"		"2,769,745	6,249."
		"6,039'			"6,259.

Page 467, line 5, in Formula, *for* "29·52" *read* "19·52"

INDEX.

DUNEDIN:
PRINTED BY MILLS, DICK AND CO., STAFFORD STREET.

8